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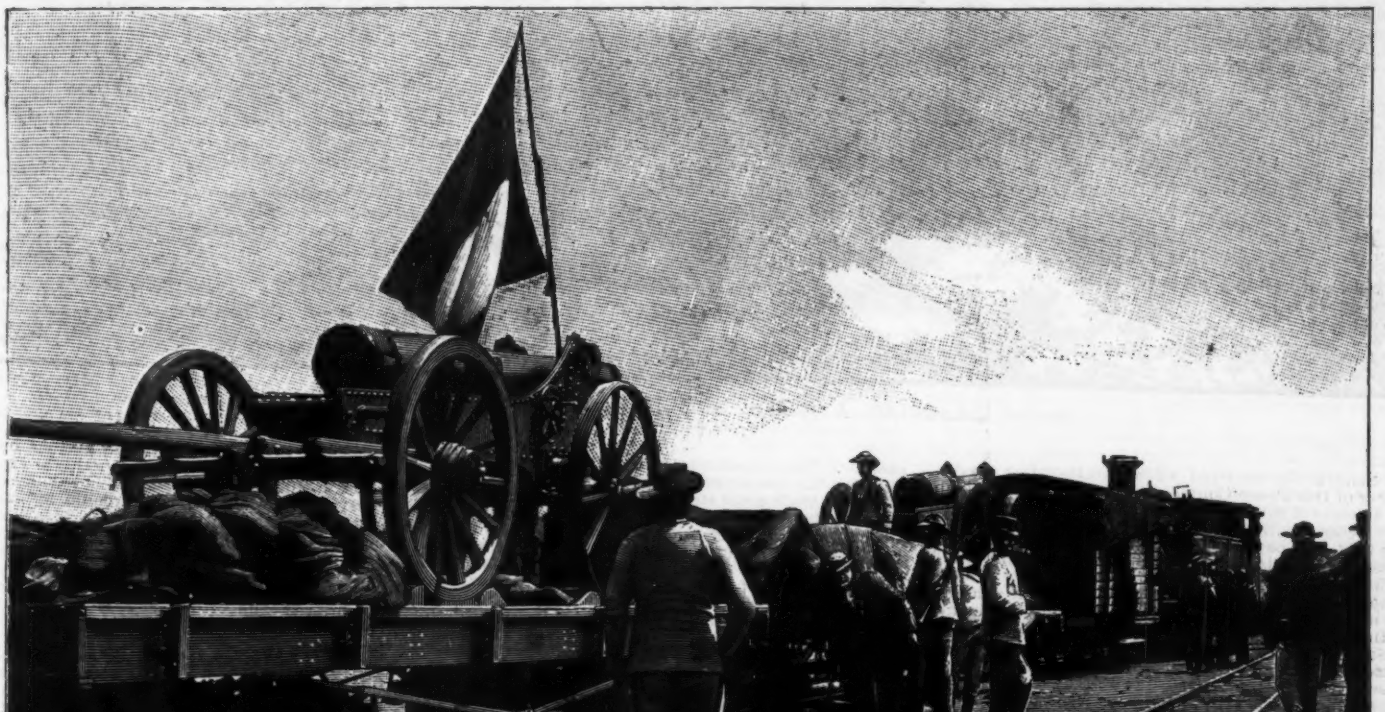
"LONG TOM" IN FIRING POSITION.



"LONG TOM" AND "MRS. SMITH" STARTING FROM PRETORIA FOR VOLKSRUST.

TWO FAMOUS BOER GUNS.

At the well-known Creusot works in France, says L'Illustration, two 155-millimeter (6-inch) guns were built for the Boers, which guns have seen active service in the Transvaal. The pieces have been respectively christened "Long Tom" and "Mrs. Smith." The accompanying illustrations graphically narrate the adventures of the latter weapon.

"Long Tom," accompanied by "Mrs. Smith," left Pretoria for the frontier of Natal on the very day on which the ultimatum of England expired. The Boers at that time were still undecided whether to take the offensive or prevent invasion of their territory.

"Long Tom" was planted on a hill near Volksrust, in the vicinity of Majuba Hill and Laing's Neck, the scene of two bloody battles fought during the last war. The English were puzzled to know how the Boers could mount such large guns in places apparently inaccessible. It was said that a hundred oxen and two hundred horses were required. But it was the strong arms of the Boers that dragged "Long Tom" up the heights of Volksrust; for animals would have gained no foothold on the steep sides of the Transvaal hills.

When General White shut himself up in Ladysmith, "Long Tom" was carried down the heights of Volksrust (a task even more difficult than mounting it on the hill) and up another mountain (Imbulwana Hill) which commanded the town.

THE GUNCOTTON PROBLEM.

By Frederick H. McGahie.

The celebration on October 18, 1899, at Basel, Switzerland, of the centenary of the birth of Friedrich Christian Schoenbein occurred a few months after the dissolving of the Peace Conference at the Hague, which had assembled to discuss the feasibility of international agreements tending toward the lightening of the burdens that the necessity of military preparedness has placed upon the leading nations. This necessity found birth in the conjunction of that military policy of state inaugurated by Bismarck and of the powerful weapons and materials of war that science and mechanics are continually developing. It was an ardent lover of peace who declared in 1544, with regard to the inventor of black powder, "The villain who brought such a noxious thing to the earth is not worthy of having his name retained on earth in the memory of man." This point of view would not have honored Schoenbein, since the discovery upon which his fame rests most solidly is that of guncotton. Its history is similar to that of nitroglycerin in that the successful employment of both explosives was attained only through continuous striving against most discouraging experiences. Even to-day, when guncotton is the basis of all military smokeless powders, the real experts are not at all satisfied with the present article of manufacture. It will be recalled that there occurred last spring, at Toulon, France, a magazine explosion in which many persons were killed. The reports given out to the press made anarchists responsible for the accident. But there were also some magazine explosions in Russia around the same time. There were curious coincidences in these cases. The powders were of the same type, the nitrocellulose-barium nitrate variety, and their age was the same, around five years. An eminent authority on explosives who was abroad at the time, and in close connection with the leading experts over there, wrote me subsequently that the consensus of their opinions was that the cause of the explosions should be considered the deterioration of the guncotton in the powders. Against this must be placed the testimony of Prof. Piccard, of the University of Basel, at the Schoenbein centenary. The university owns a rifle used by Schoenbein in his experiments, and a batch of guncotton cartridges prepared for it by him some fifty years ago. One cartridge had been fired in this rifle twenty-five years after its preparation. Prof. Piccard made a similar test of another cartridge, when the batch was fifty years old.

The ballistic results obtained in both firings were practically identical with those obtained by Schoenbein himself, showing that no chemical change had taken place in that time. The curious part of the case is that Schoenbein prepared his guncotton in ignorance of a purification process that is all-important in the modern methods of manufacture.

Braconnot discovered in 1832 that starch and similar bodies were transformed by the action of nitric acid into highly combustible substances. Pelouze extended this observation to many other organic bodies including cotton and paper. Dumas proposed to make paper thus treated into cartridges. No practical use could be made of these new explosive compounds, as they were decidedly deficient with regard to uniformity and stability. In 1845 Schoenbein made the announcement that he had discovered a new explosive which was a powerful and smokeless propellant. He named it guncotton and kept his processes secret. The following year Boettger stated he could make guncotton also. The two men then got together and, finding their methods identical, united in offering guncotton to the German Union as a secret and superior gunpowder. Their methods were made public in a few years by the researches of other chemists, and it was seen that their great step had been in using a mixture of concentrated sulphuric and nitric acids in treating the cotton, the former acid taking up the water formed by the reaction and maintaining thereby the nitric acid at its original strength. This gave a uniform product more or less free from the unstable weaker forms of guncotton. As this new explosive gave no smoke or residue, and, in comparison with the black powder of the day, was less hygroscopic, less affected ballistically by moisture, and capable of producing equal velocities with one-fourth the weight of charge, several countries began experiments with the view of replacing black powder by guncotton. Unsatisfactory results and bad accidents caused the abandonment of these attempts except in Austria, where General von Lenk attacked the problem with great ingenuity and comparative success. The points he insisted upon were the purification of the cotton, the employment of the strongest commercial acids, careful attention to all details to secure uniform and high nitration, and thorough washing of the nitrated product. These conditions gave a much improved guncotton. It burned however so rapidly that in a gun the whole charge was converted into gas before the shot had moved from its seat, with a consequent excessive straining of the breech in securing desired velocities, an action bad enough with their black powder. The desideratum of good ballistics is that the powder gases should be gradually and increasingly evolved with the movement of the projectile, so as to sustain the pressures along the bore and subject each section of the gun to strains proportionate to its strength. By spinning nitrated cotton yarn into ropes a denser form was obtained that burned considerably more slowly in the air but proved of no value in ordnance, the igniting gases penetrating at once throughout the interstices. Since a low density of loading keeps down pressures by affording a large expansion volume, Von Lenk introduced the clever device of wrapping this guncotton rope around a closed hollow cylinder designed to collapse at a medium pressure and thereby increase the powder chamber in a desired ratio. As a result of Von Lenk's work, Austria had introduced into her service 30 batteries employing guncotton as the propelling agent before it was found necessary to abandon the new explosive as a gunpowder. In spite of all precautions taken, the charge would detonate every now and then and wreck the gun. There were also unexplained explosions of guncotton magazines in 1862 at Simmering and in 1865 at Steinfeld. In 1865, Frederick Abel, of the English War Department, patented an improvement on Von Lenk's process, giving a method now in universal use. He found that the tubular structure of cotton, which does not break down during nitration, allowed the retention of acid by the interior of the tube that could not be wholly removed by any subsequent commercial washing of the guncotton in the physical condition it had on leaving the nitrating bath. This acid originated decomposition that would pass under favorable conditions into spontaneous explosion. Abel's improvements consisted in grinding the guncotton into a fine pulp in a paper grinding machine, washing this pulp thoroughly, and forming it into cakes under very heavy pressures. Dried cakes thus prepared were tried in field guns, since their density made them burn very slowly in the air, but all the old objections obtruded themselves. The use of guncotton remained restricted to blasting and the various operations of military practice calling for a high explosive. Its value in this line was considerably enhanced by the discovery of E. O. Brown, that it could be exploded most advantageously by the detonation of a small amount of mercury fulminate. It was further found that guncotton cakes containing enough water to render them uninflammable gave a more violent effect than the dry cakes and that the proper detonating agent for wet, compressed guncotton was a small cartridge of dry, compressed guncotton, the explosion of the latter being determined by a primer of mercury fulminate. The Von Lenk process as modified by Abel was gradually adopted by all the military countries, and guncotton became firmly established as a service high explosive. The Stowmarket works in England had a serious explosion of 13¼ tons of dry compressed cakes in 1871, but a thorough investigation led to the belief that acid had been maliciously added to the guncotton after it had been tested satisfactorily as to its quality. Since then there have been no other factory accidents that have raised any doubts as to the stability of guncotton.

It became known in 1886 that France had a satisfactory smokeless powder for the advocated small-bore rifle. Samples of Vieille's "poudre B" were soon in the possession of the experts of other countries and its secret became common knowledge. He had mixed guncotton with a sufficient amount of a liquid solvent to gelatinize it completely, formed the resulting pasty mass into a sheet of determined thickness, and cut this sheet up into small, square grains which were then dried by hot air to constant weight. This treatment gave a hard, colloidal form of guncotton with the abso-

BOERS DRAGGING A 155-MM. GUN UP THE HEIGHTS OF VOLKSRUST.

lute density and possessed consequently of the property of surface combustion. It had markedly lost the property of detonating and had a low velocity of combustion. In consequence of these characteristics, the shape and dimensions of gelatinated guncotton grains permitted the control over the combustion of the charge needed to meet the varying requirements of different guns. This process of gelatination is the foundation of the transformation of a violent high explosive into a service gunpowder. Gelatinated guncotton is the basis of all military smokeless powders. The half step in this direction had been made in 1882 by Reid and Johnson in England, when they introduced to the sporting world "E. C." smokeless powder. They mixed pulped guncotton with metallic nitrates, worked the mixture up into small rounded grains, and hardened these grains by spraying them with a solvent.

The action was a surface one entirely that gave a firmer grain, and reduced, somewhat, the violence of combustion of the untreated guncotton. This powder was tested in the military rifle, but proved too variable in its ballistics and too violent in its action. It remained for Vieille to recognize the value of complete gelatination.

A recent patent suit in the English courts, that of Heidemann vs. the Smokeless Powder Company, brought out some most interesting information showing that gelatinated guncotton had been tried and abandoned shortly after Schoenbein had offered guncotton to the military world. The facts are contained in a pamphlet by Dr. Th. Hartig, published at Brunswick in 1847, and entitled. "Untersuchungen über den Bestand und die Wirkungen der explosiven Baumwolle, mit besonderer Berücksichtigung des mikroskopisch Nachweisbaren vor, während und nach der Explosion." Dr. Hartig had become acquainted with guncotton through witnessing some of Schoenbein's experiments with it in small arms. The pamphlet has instructions for making guncotton, which, when followed in 1897, gave a grade of military guncotton as strong as any that was being produced in this country. He states, with regard to gelatination: "I have found that guncotton added in very small quantity to acetic ether swells with it to a thin, or if added in a larger quantity, to a stiff jelly, which is as clear as water. In doing so it does not change its chemical composition. When the jelly is put upon a sheet of glass in a thin layer, a snow-white residue remains upon the evaporation of the ether. This substance shows in every respect the same properties as guncotton." Dr. Hartig experimented with guncotton thus treated as a smokeless powder for small arms with unsatisfactory results. His conclusions were: "Every consolidation, or increase of density, of the explosive charge, whether produced by spinning, weaving, or by treatment with acetic ether, is accompanied with a loss of propulsive power." We know now that the failure of gelatinated guncotton in Dr. Hartig's experiments arose from the fact that the muzzle-loading, smooth-bore rifle of his day did not give that resistance of the projectile necessary for the proper combustion of such a dense form of guncotton. He was not aware also of the need of grains of definite dimensions and a strong igniting flame for the satisfactory employment of gelatinated guncotton. The recognition of these considerations began with Vieille's powder, the influence of the primer being known only to a few as late as 1891. It is worth noting that most of the smokeless powders for small arms developed after the discovery of the secrets of "poudre B" were laminæ of military guncotton gelatinated by acetic ether. In gelatinating nitrocellulose and working it up into rods and tubes, the celluloid business antedated the powder business by some ten years, Daniel Spill having taken out a patent to that effect in 1875. But, as stated previously, it was Vieille who recognized the real value of gelatinated guncotton powders in meeting the demands of high-power, breech-loading, rifled guns.

Guncotton is the name given to those varieties of nitrocellulose that are used in the military world. Nitrocellulose is yet a puzzle in many respects, from the point of view of both theory and practice. The molecular formula of cellulose is some multiple of the simple analysis formula $C_6 H_{10} O_5$. When treated with a mixture of nitric and sulphuric acids, cellulose is transformed into a series of nitrocelluloses with varying chemical, explosive and physical properties. On account of their chemical reactions, cellulose is regarded as an alcohol, and the nitrocelluloses as nitric ethers. A certain number of the H atoms in the cellulose molecule are replaceable in part or in whole by the NO_2 groups furnished by the nitric acid. Since the amount of NO_2 in a nitrocellulose determines its explosive strength, it is the custom to specify the grade of a guncotton by its percentage of N. Taking $C_6 H_{10} O_5$ to represent cellulose, there are three replaceable H atoms, and accordingly three possible nitrocelluloses:

Mononitrocellulose—$C_6 H_7 O_5 (NO_2) H_2$—with 7·34 per cent. N.
Dinitrocellulose—$C_6 H_7 O_5 (NO_2)_2 H$—with 11·13 per cent. N.
Trinitrocellulose—$C_6 H_7 O_5 (NO_2)_3$—with 14·14 per cent. N.

This was the theory of Abel, but the researches of Eder, Vieille, and others revealed intermediate compounds calling for a more complex cellulose molecule. Considering it $C_{12} H_{20} O_{10}$, we have six replaceable H atoms and six possible derivatives running from the mono with 3·79 per cent. N to the hexa with 14·14 per cent. N. If we start with $C_{24} H_{40} O_{20}$, there are twelve theoretical nitrocelluloses, ranging from the mono with 2·02 per cent. N to the dodeca with 14·14 per cent. N. Some hold to $C_{48} H_{80} O_{40}$. However, no investigator has satisfactorily isolated the various nitrocelluloses corresponding to any theory adopted by him. No higher form than that represented by 14·14 per cent. N has yet been produced. Claims to this effect have not been substantiated. If it is ever done, it will mean either more replaceable H atoms in the cellulose molecule or another empirical formula for it, Dr. Berthsen suggesting $C_6 H_8 O_4$ as a possibility.

The variables of nitration are strength of the acids, proportion of the acids, time of nitration, and temperature at which the nitration is conducted. Changes in these variables produce many varieties, differing in their nitrogen amounts by small degrees, and which must be considered as mixtures in varying proportions of the definite forms of nitrocellulose. These are broadly divided into soluble and insoluble guncottons, in accordance with their action with a mixture of ethylic alcohol and ethylic ether, the insoluble ones comprising the strongest guncottons. It was formerly thought that there was a dividing line between them corresponding to about 12·75 per cent. N. But this does not hold now, since both forms have been made between the limits of 12·75 and 13·2 per cent. N, and there seems to be no reason why future work should not extend these. The explanation of this and kindred phenomena must be sought in the spacial relations of the atoms in the molecule as interpreted by stereo-chemistry. There is no real scientific knowledge of the value of the variables of nitration. An indication of their complex interdependence may be gathered from a few cases.

The manufacturer of gelatin dynamites needs a grade of nitrocellulose which unites with nitroglycerin under the influence of heat. The company producing the best grade to be had in this country experimented with over two hundred varieties before they hit upon their special article, and it is found that every now and then a lot prepared with the usual precautions, and answering to nitrogen and solubility tests, refuses to "jelly" at all with nitroglycerin. The celluloid business consumes a very large amount of pyroxylin of about 10·8 per cent. N, and finds many anomalies, as, for instance, when a batch of pyroxylin that has passed satisfactorily the chemist's tests, will give celluloid working very well, with the exception of taking a polish. The subject affords many fascinating problems for the scientific chemist.

As a military high explosive, guncotton is eminently satisfactory. It can be made with complete safety. It is stored and used in wet, compressed cakes, in which shape it is free from all danger through fire or heavy shock, and from liability of disastrous explosion in case of decomposition setting in. It will keep indefinitely in the wet state if it tests up to the present standards, and its full explosive power is easily provoked by suitable primers. The only line in which it is being superseded is as a filling for explosive shells, whose small capacities make the question of the combined strength and density of the explosive charge all-important, the explosives employed being based upon picric acid and its derivatives. But they have bad faults, especially with regard to deterioration in storage and the need of complicated detonators. It is said that the French authorities have to recharge their melinite shells every year. This trouble killed emmensite in this country, and thorite has yet to demonstrate its keeping qualities.

For employment in smokeless powders, the real experts have had greater faith in the present article of manufacture than they have now. We have noted their opinion in regard to the Toulon and Russian explosions, in which cases the absence of nitroglycerin in the stored powders made it impossible to impute the trouble to that scapegoat. There had been other phenomena that had tended to shake their faith. The belief now held by them is that when the best grade of guncotton now on the market is worked up, with or without other compounds, into a smokeless powder by means of a solvent, the powder may be relied upon to keep well in storage for three to five years, but beyond that there is a great likelihood of deterioration, possibly strong enough to cause explosion. What the influence of the other explosives and the solvent is remains for more careful study. It has been recently noticed abroad that acetone has a slightly deleterious influence upon guncotton. The call is at least for a better article, and the German Powder Trust, which has been investigating the matter for many years, states that it is now able to make a guncotton of great superiority. Figures that have been given privately point out a guncotton with wonderful stability in comparison with accepted standards.

Police Protection in Marseilles: American Patrol System.—Consul Skinner, of Marseilles, under date of November 23, 1899, says:

Frequent criticism of the night police service of this city has been followed within the past few days by the partial application of a new system of patroling the streets. Until now, the rule has been for two officers to cover each beat together; but as there are less than 150 men available for the service in a town of over 500,000 inhabitants, it frequently happened that policemen were far away when most urgently needed. As a partial remedy, it is now arranged that each man shall have his own beat, meeting his neighbors at regular intervals and calling for assistance, when it is required, by a set of whistle signals. In the existing state of public sentiment, it occurs to me that this would be an opportune moment to suggest to the municipal authorities the many advantages of the American patrol-wagon system, with the electric police calls scattered about the city. I am inclined to believe that a proposal to reorganize on American lines would be well received, and at all events it could do no harm to make the effort. Correspondence should be in the French language and addressed to Monsieur le Maire de Marseille, Hôtel de Ville, Marseilles. The assistant mayor charged with matters relating to the police is Fortuné Joseph Ambard, 58 Boulevard de la Corderie.

VIBRATING TABLE FOR TESTING ACCUMULATORS.

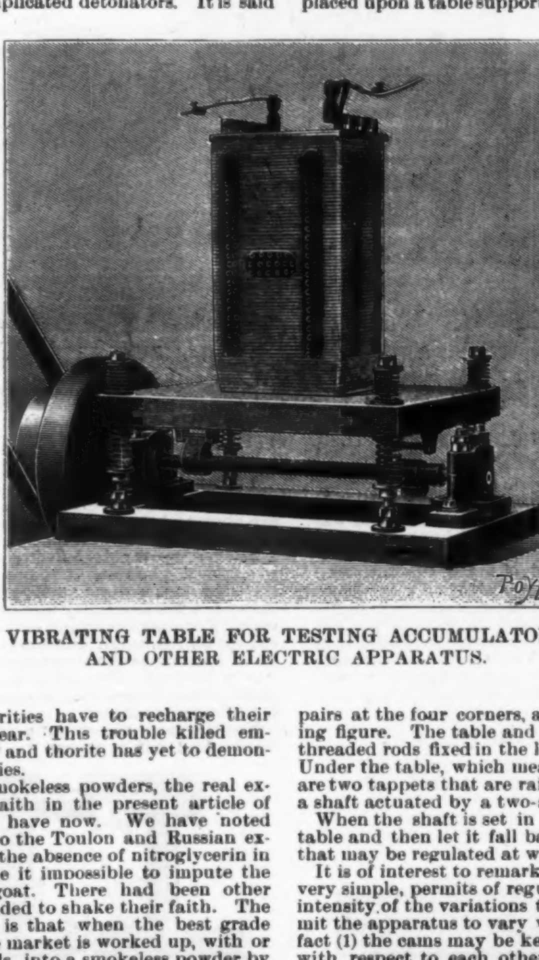
Experience with electric automobiles soon showed (what, however, was easy to foresee) that accumulators placed upon carriages undergo deterioration much more rapidly than those that are installed in a stationary manner, in consequence of the vibrations inherent to the running of the vehicle.

The Automobile Club of France rendered perfectly apparent the prime importance of the resistance of accumulators to destruction due to shocks by submitting to continual vibration all the accumulators that were used in the competition that recently took place. The comparative results of such treatment will be interesting to study.

On another hand, it is profitable to ascertain what influence vibrations exert upon electric measuring apparatus, such as amperemeters, voltmeters, etc., placed upon electric automobiles.

In order to answer such questions, which had often been put to it by various manufacturers, the Central Laboratory of Electricity has devised a vibrating table that permits of submitting accumulators or measuring apparatus to vibrations as similar as possible to those that they would have to undergo upon an automobile.

The accumulator or apparatus under experiment is placed upon a table supported by eight springs placed in pairs at the four corners, as shown in the accompanying figure. The table and springs are guided by four threaded rods fixed in the lower frame, forming a base. Under the table, which measures 23 × 14 inches, there are two tappets that are raised by cams mounted upon a shaft actuated by a two-speed cone pulley.



VIBRATING TABLE FOR TESTING ACCUMULATORS AND OTHER ELECTRIC APPARATUS.

When the shaft is set in motion, the cams raise the table and then let it fall back, and thus cause shocks that may be regulated at will.

It is of interest to remark that this system, although very simple, permits of regulations such as to cause the intensity of the variations to which it is desired to submit the apparatus to vary within very wide limits. In fact (1) the cams may be keyed at any angle whatever with respect to each other; (2) to the lower and upper springs may be given variable tensions through jam nuts; (3) the table may be loaded with weights of variable size; and (4) to the cam shaft may be communicated a greater or less velocity.

We shall not dwell upon the services that such an apparatus may render to electric automobilism. It will permit manufacturers to ascertain in advance how such or such a style of accumulator will behave; and thus, many annoyances will be avoided. It will be possible to learn what influence vibrations have upon measuring apparatus, and it will be found that they produce curious and unexpected results.—La Nature.

Packing Goods for China.—The trade in goods coming in parcels by mail from the United States to and through this port has been rapidly increasing of late, says Consul-General John Goodnow, of Shanghai. More care, however, must be taken in packing such goods. In the last mail there was a large number of these packages sent as registered mail, and in almost every instance they were received at this office broken. Most of them were in paper boxes; some were in wooden boxes. All such were broken. Shippers must remember that mail sacks are liable to rough handling in being put into the hold of ships, and that much more care must be taken in wrapping goods for China than for points in the United States.

In this mail, I noted especially one shipment of eye-glasses, packed in a wooden box of flimsy make. The

box had collapsed, the paper wrapping had broken, and the glasses were scattered through the bag, some being broken. The fault was entirely due to careless, slipshod packing.

The Chinese post will not take damaged parcels for interior points. All we can do is to send notice to the party to whom the package is directed that we hold for him a damaged package, and that he must get some friend to call for the package and forward it as best he may. All this results in loss of time and trade.

THE MANUFACTURE OF COAL-GAS.

In order to generate illuminating gas, anthracite coal is burnt in clay retorts which are walled together in a large furnace. One end of each retort is closed; the other end is provided with a door through which fuel is shoveled and the ashes and coke raked out. Instead of heating the retorts directly, as in the old way, fuel-gas is nowadays used. The fuel-gas generators are located beneath the retorts and are particularly serviceable for the production of high temperatures.

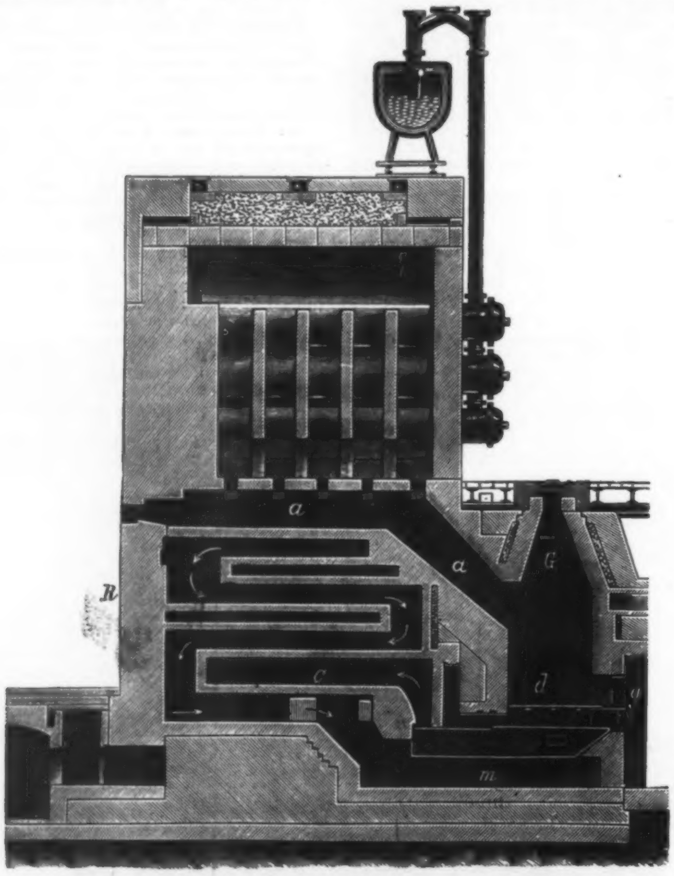


Fig. 1.—FURNACE PROVIDED WITH FUEL-GAS GENERATOR.

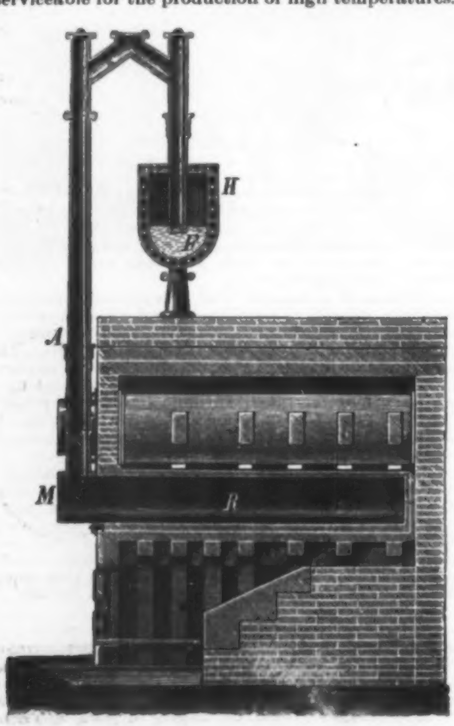


Fig. 2.—HYDRAULIC MAIN.

R, retort; *M*, mouthpiece; *A*, rising-pipe; *H*, hydraulic main; *F*, water.

The fuel in the generators is not allowed to burn with a full flame; it is merely heated to incandescence. Air is allowed to reach only that portion of the fuel lying immediately upon the grate. Carbon dioxide gas is formed, which passes up through the superposed layers of incandescent coal, combines with the carbon and forms inflammable carbon monoxide, which mingles with the products of distillation of the coal just introduced within the generator. The fuel gas is then mingled with air; and the mixture when ignited produces an intense heat.

The principle has been successfully applied in most modern gas works, and is used in the Schilling-Bunte furnace, represented in Fig. 1, reproduced from Stein der Weisen. Fuel is introduced within the generator, *G*. The gases are conducted through the passage, *a*, to slots beneath the retorts, where they are mingled with air and burnt. But the products of combustion, before entering the chimney, pass through a regenerator, *R C*, and give off most of their heat. Air is conducted through the regenerator for the purpose of burning the fuel-gas and of obtaining a more intense heat than would otherwise be possible.

The charging of the retorts is a very difficult operation which requires great skill. As soon as the retorts are open and the burnt coke raked out, coal is shoveled in a uniform layer into the retorts. The charging must be very rapidly effected, so that as little gas as possible will be lost.

Owing to the disadvantages of charging by hand, many gas works employ inclined retorts open at both ends. Through the upper end coal is fed by a mechanical stoker; through the lower end the coke is raked out. As soon as the retorts are closed, the coal evolves gas in gradually decreasing quantities. At the end of three or four hours coal is entirely exhausted and gas is no longer produced.

But the gas is as yet not a pure illuminant; it must be cleansed before it can be burnt. First, it is conducted to the hydraulic main, in which the heavy volatile parts are condensed and conveyed to a receptacle by means of siphon-shaped pipes. In the hydraulic main the gas passes through a layer of water and tar; by which the retorts are hydraulically separated, so that gas is prevented from escaping while one retort is being charged. As the gas enters the hydraulic main, it meets with a resistance varying with the number of purifying apparatus employed. In order to overcome this resistance, the gas must be compressed in the retorts until its pressure is sufficiently great to enter the main. This pressure affects both the amount of gas obtained and the illuminating power.

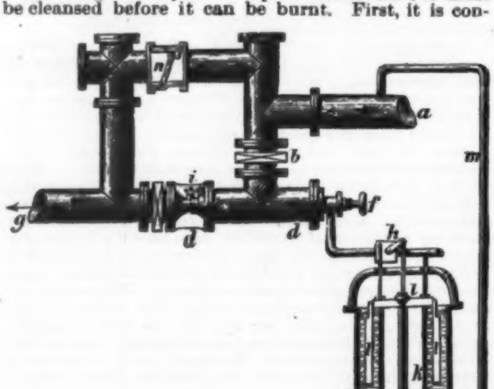


Fig. 3.—STEAM-JET EXHAUSTER.

The walls of the retorts are by no means completely impenetrable; on the contrary, they are exceedingly porous and offer a means of escape to the gas. The quantity of gas thus lost is small; but it increases with the pressure. On the other hand, the gas, in order to overcome a great resistance, is retained within the heated retort often long enough to affect its composition unfavorably, so that those constituents particularly rich in carbon—the light-giving element—are decomposed into marsh gas and gas carbon when they come into contact with the white-hot walls. The quantity of gas obtained is thereby lessened and its illuminating quality impaired.

In order to overcome this objection, devices are used in connection with the hydraulic main which serve to maintain the pressure within the retort at the lowest possible point. These devices—"exhausters" they are called—are of various forms. The simplest are those of the steam-jet type, pictured in Fig. 3. The gas enters at *a*, in the direction of the arrow, passes downwardly through the slide valve, *B*, into the horizontal pipe, *d*, with which is connected the steam-pipe provided with the valve, *f*. The steam escapes at the conical nozzle, *i*, under pressure, forces the gas through *g*, to the purifier. The velocity with which the steam escapes at *i* depends upon the exhaustive and pressive effect of the steam blast. The steam is automatically supplied by means of the throttle valve, *k*, the lever of which is operated by a water-sealed bell, *l*, which receives the gas from the by-pass, *m*, in quantities varying with the pressure at *c*, and, hence, in the hydraulic main. If the pressure increase, the bell rises; the throttle-valve is still open; more steam is supplied; the steam-blast has a greater exhaustive effect, and the gas pressure falls. When the pressure sinks too low, the steam supply is correspondingly reduced. If the exhauster be cut off by the closing of the slide valve, *b*, the gas passes through a valved auxiliary pipe, *n*, directly to the purifier.

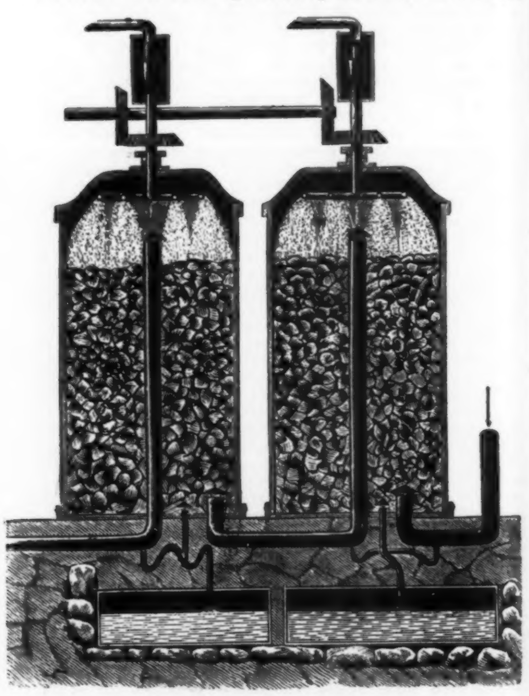


Fig. 4.—SCRUBBER.

The gas which has passed through the hydraulic main and the exhauster is still charged with uncondensed tar. To remove this tar, the gas is conducted through a system of long vertical pipes in which the gas is cooled and the tar condensed. These pipes are usually placed in the open air, in order that the cooling may proceed more rapidly.

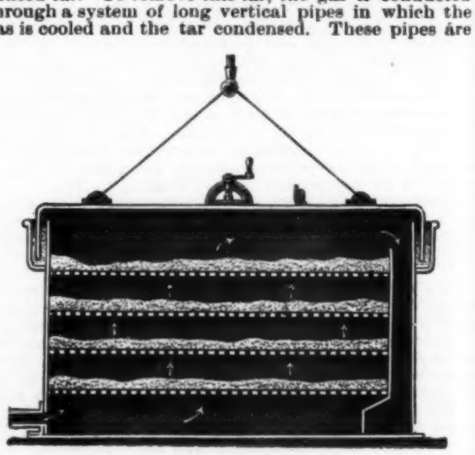


Fig. 5.—PURIFIER.

Even after it has emerged from the condenser, the gas still contains volatile impurities which must be removed by washing. The apparatus used for this purpose is called a scrubber and is composed of vertical iron receptacles, filled with coke or pieces of brick. Water sprayed from a rotary sprinkler trickles down through the coke. The gas to be purified enters by means of a pipe, ascends through the coke, and intimately mingles with the water. After passing through one scrubber, the gas is conducted to a second, whereby the last traces of tar and ammonia and part of the sulphuric acid are removed.

By means of the hydraulic main and scrubber, the gas has been mechanically purified. It must now be

subjected to a chemical purification. But before this chemical process is described, it will be necessary to mention some of the products obtained by distilling coal.

One of the products of distillation is ammonia, which, owing to its aqueous nature, readily mingles with water. Tar, on the other hand, possesses more the consistency and appearance of a black oil, does not mingle with water, and is composed of many substances, the separation of which from the tar is the work of special, large manufactories.

Of the constituents of illuminating gas, we must distinguish the vapors from the gases. The vapors condense very rapidly into fluids or solids on a slight reduction in temperature; but the gases retain their form, even at very low temperatures. A distinction must also be drawn between the heat-giving and light-giving constituents of gas. The former burn with an intense heat, but with little light; the latter burn with a bright light with very little heat. Of the gaseous impurities, nitrogen, oxygen, and the sulphur-carbon compounds are most important.

By coke is meant the residue left in the retorts after distillation. The coke contains 90 to 95 per cent. of carbon and 10 to 5 per cent. of iron sulphate. It is very widely used as a fuel.

When the gas emerges from the scrubber, it has been deprived of its tar and most of its sulphur compounds; but it still contains many impurities, which must be removed before it can be used as an illuminating gas. Among these impurities the most important are the remaining sulphur compounds, which are converted into sulphuric acid on burning the gas, and which, if not removed, would impair the illuminating quality. Carbon dioxide, which diminishes the illuminating power, and finally certain cyanides, must also be removed.

The separation of all these impurities can be effected only by converting them into insoluble compounds. Formerly slaked lime was used for this purpose, spread out in layers within boxes, and the gas passed through and over these layers. The carbon dioxide coming into contact with the slaked lime formed calcium carbonate. The sulphureted hydrogen and carbon bisulphide formed sulphur compounds. But the compounds thus obtained were again decomposed by carbon dioxide. In order thoroughly to purify the gas, it was therefore necessary to use very large quantities of lime to absorb all the carbon dioxide and to prevent decomposition of the sulphur compounds.

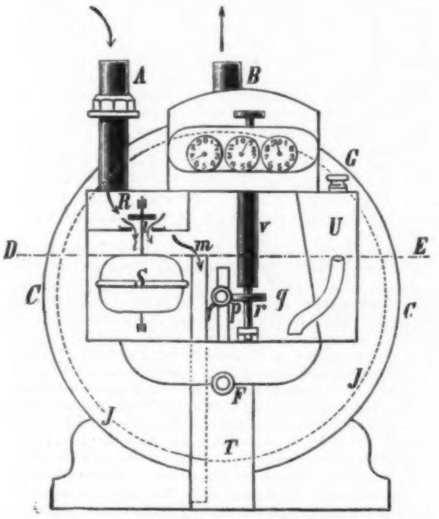


FIG. 6.—SECTION THROUGH A GAS-METER.

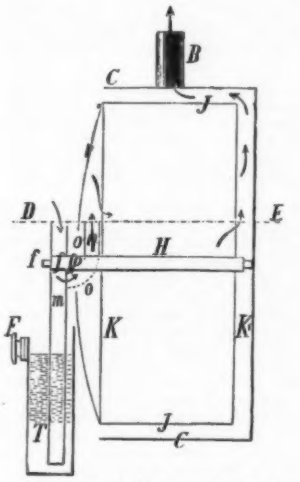


FIG. 7.—SECTION THROUGH THE DRUM OF A GAS-METER.

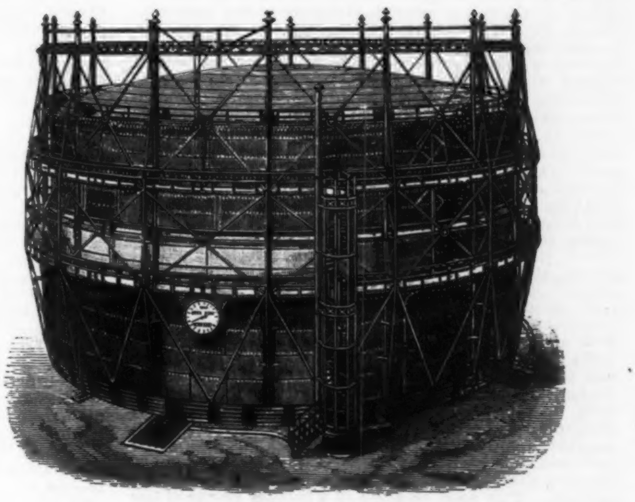


FIG. 11.—A TELESCOPING GAS-HOLDER.

The Laming process, which has been widely used in Europe, employs hydrated sesquioxide of iron, prepared by mixing copperas (iron sulphate) with slaked lime and sawdust, and exposing the mixture to the air to oxidize the protoxide of lime to the sesquioxide. The resulting mixture contains hydrated iron sesquioxide, calcium sulphate, and sawdust. The material is very effective in removing the sulphur compounds from the gas, and is not offensive when fouled with sulphur. It loses its efficiency as soon as the iron sesquioxide is used up and has been converted into iron sulphate. In order to restore it to its former activity it is exposed to the air for several days. The oxygen of the air combines with the iron sulphite, again forming iron sesquioxide, the sulphur being then separated. The process can be repeated until the mass has lost its efficiency by the precipitation of tar and the separation of sulphur. But even then it is not entirely worthless; for it contains valuable cyanides. Of late, purifiers have been used consisting of iron hydroxide, which also regains its efficiency on exposure to the air. In order to save the expense of constantly stirring the material when it was exposed to the air, the expedient was resorted to of mixing the illuminating gas with one-half per cent. of oxygen; the purifying material is thereby made to serve as an oxidizer, which decomposes the hydrogen sulphide into water and sulphur. This method is widely used in England, where greater stress is laid upon a gas free from hydrogen sulphide than on the Continent.

Still another method of purifying, devised by Claus, deserves to be mentioned. The process consists in passing the gas through several scrubbers and intimately mingling it with ammonia. The resulting mixture is composed of carbon dioxide, hydrogen sulphide, ammonium sulphite, and cyanides.

The purifiers consist of closed iron boxes or casings in which the material is arranged in layers. The gas enters at the bottom, passes up through the layers and into a pipe leading from the top of the box. The boxes are provided with heavy water-sealed covers, which can be raised by block and tackle.

After purification the gas passes through the meter at the gas works, by which it is measured. This measurement of gas is important, not only for the purpose of ascertaining the amount generated, but also of detecting leakages in the mains. The amount of gas used by every consumer is recorded by a small meter; and the total amount registered by these small meters must correspond approximately with that registered by the meter at the gas works. Since there is always a slight loss, the two records will never agree exactly.

Every wet gas-meter consists of three parts: a casing, a drum, and a registering mechanism. The casing, *C C* (Fig. 6) is cylindrical in form and is made of sheet iron. At the front portion of this cylinder is a gas inlet pipe, *A*, and at the central upper section a gas outlet pipe, *B*. The casing is furthermore provided with openings, *F* and *f*, closed by screw-caps. Through the opening, *G*, glycerin is poured into the casing; the opening, *F*, serves to indicate the proper level of the water or glycerin.

The drum of the meter (Figs. 7, 8 and 9) consists of a cylinder made of britannia and mounted on a shaft, *H*. The outer envelop is entirely closed; but the two heads, *K* and *K'*, are provided each with four slots, *L*, *M*, *N*, *O*, and *L'*, *M'*, *N'*, *O'*, respectively. The gas enters the slots, *L*, *M*, *N*, *O*, of the forward head, *K*, and passes through the slots in the rear head, *K'*, of the drum. The interior of the drum is divided into four equal compartments, which form buckets. Into the buckets opens one of the slots of each head. These two slots form an angle of 90 degrees with the shaft of the drum and of 180 degrees with each other; in other words, they lie on opposite sides of the drum-shaft. In order to effect this arrangement, the partitions are screw-formed. The gas enters the forward, upper slot, and would immediately pass out of the lower, rear slot were it not for the intervening water or glycerin. In Fig. 6 the envelop of the drum is indicated by the dotted circle, *J*. The casing is filled with water up to the line, *D E*. The gas enters the slot, *L*, exerts a certain pressure on the partition, *O*, as well as upon the water. Since the water resists the pressure and the drum is revolubly mounted, the pressure will turn the drum until the slot, *L*, registers with the slot, *O*; the gas will then pass through the water. But in the meantime the slot, *L'*, has been brought into register with the slot, *O'*; hence, the gas rises through the water, passes out of the last-named slots into the empty space between the casing and the drum, and is led away by the pipe, *B*. The buckets are completely separated from one another, and each contains a definite quantity of gas. Since a bucket begins to be emptied only when it is completely filled, and is then closed, the gas is thus measured. The movement of the drum cannot be interrupted; for if one bucket be not quite full, the next immediately begins to receive gas.

The registering mechanism of the motor is driven by means of an endless screw, *p*, on the forward extremity of the shaft, *H*, meshing with a horizontal worm wheel, *p*, carried at the lower end of a vertical shaft, *r*, whereby the movement is transmitted to the registering apparatus. The quantity of gas which has passed through the meter can then be read from the dials.

After passing through the main meter at the works, the gas flows into the gas-holder or "gasometer," as it is erroneously termed. The gas-holder is a large water-sealed bell of sheet iron, rising and falling in vertical guideways. In the lowermost position of the bell the water almost touches the top. As the gas enters, the increasing pressure forces the bell up. When the bell is filled, the gas supply is cut off and the distributing pipe opened.

A gas holder of large capacity would require a water tank, the depth of which would equal the height of the bell. Such a tank would be exceedingly costly, for which reason, the gas-holder is constructed on the telescope plan. Gas-holders of this type are composed of several sheet iron cylinders telescoping within one another. The lower edge of each cylinder is bent outwardly, to form a flange or receptacle for water; and the upper edge is bent inwardly. Thus a series of superimposed, water-sealed gas-holders is produced, adjustable one within the other. For gas-holders of this type a water-tank is used, the depth of which is equal only to one-third the maximum height of the bell.

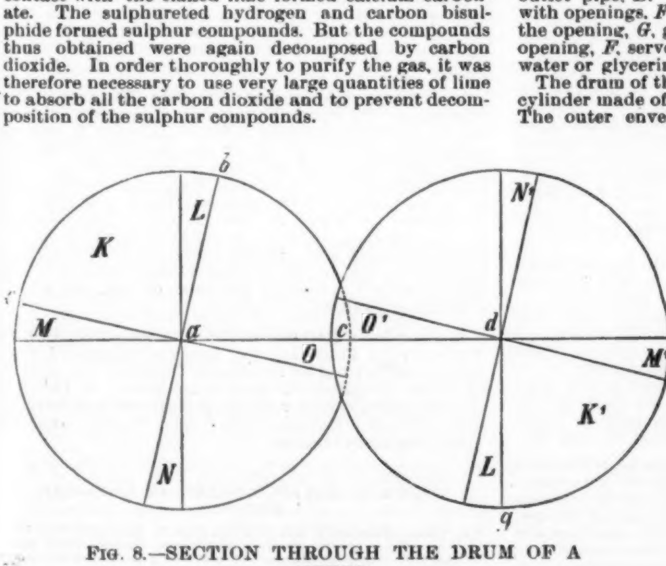


FIG. 8.—SECTION THROUGH THE DRUM OF A METER.

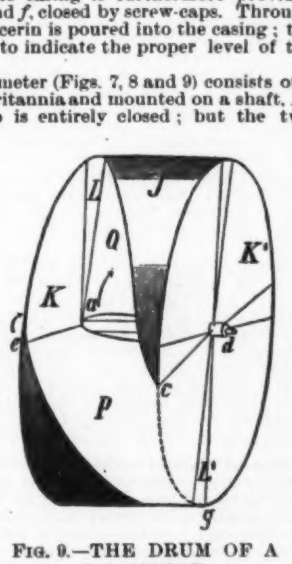


FIG. 9.—THE DRUM OF A GAS-METER.

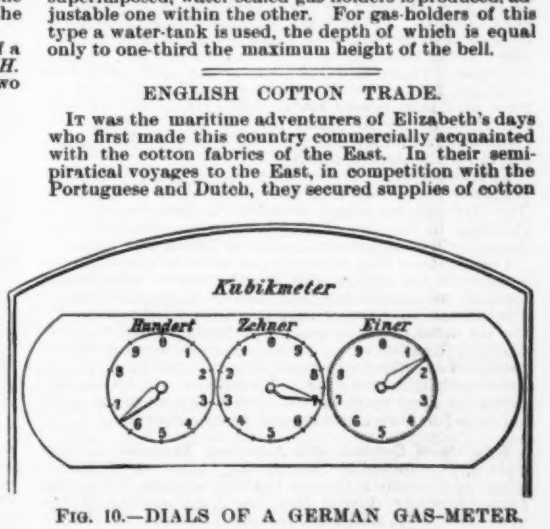


FIG. 10.—DIALS OF A GERMAN GAS-METER.

ENGLISH COTTON TRADE.

IT was the maritime adventurers of Elizabeth's days who first made this country commercially acquainted with the cotton fabrics of the East. In their semi-piratical voyages to the East, in competition with the Portuguese and Dutch, they secured supplies of cotton fabrics, calicos, muslins, prints, and dyed textures, which, when brought home, won the favor of those best able to purchase them, who paid good prices for them. Thus, on the one hand, a stimulus was given to maritime adventure in the East, and on the other, with the spreading favor accorded to these fabrics, a spirit of jealousy was aroused among the textile workers at home, who could not hope to rival the fairy-like productions of India. Thus the elements of a conflict were soon generated, and this developing, the most important consequences flowed therefrom. Strong efforts were made to crush out the new trade by legislative measures, heavy punishments being decreed by law against the importers and users of them, and it was made a penal offense to bury the dead in any other

fabric than one of wool. But the trade was only driven into subterranean channels; an extensive system of smuggling soon grew up, and the use of Indian fabrics continued to extend. The native artisans were foiled; there was nothing left to them but to contest the advance of the new favorites as best they could, and the outlook before them, as far as they could see, was not bright. But, unawares to them, they were living in that dark hour which precedes the dawn, the dawn of a brighter day than has ever yet arisen except once before upon the earth. It was the dawn of the day of emancipation of all workers from the slavery of manual labor, which was accomplished by the revolution in our industrial system. This has transformed them in the course of a couple of centuries from manual to mechanical ones. About the time we have been speaking of, the great wizard of mechanics made his first appearance upon the scene, incarnated in the person of young John Kay, of Bury, in Lancashire, the son of a woolen manufacturer. Young Kay invented the fly-shuttle, which enabled one weaver to do the work it before required four to produce; while in the case of the wider fabrics, which needed two weavers to each loom, one weaver, with the new invention, could do the work of eight. This disturbed the whole of the industrial system; cotton wefts could not be obtained in sufficient abundance, and the weavers had to "play" more than half their time owing to their scarcity. The weaving trade waited for another inventor to redress the balance. He made his advent in the person of James Hargreaves, of Blackburn, who, in 1766 or thereabout, invented the multiple-thread spinning wheel, which afterward became known as the "spinning jenny." This machine was the most wonderful ever seen up to that time in connection with the textile industries. It first spun eight threads at a time, which were soon increased to twenty. Still, these were only wefts; it could not make warp yarn strong enough. But the celebrated barber who afterward became Sir Richard Arkwright came close upon Hargreaves' heels with his spinning machine based upon the different principle of the flax wheel. This would also spin a number of threads at a time, and, what was better, the yarn could be used for warps. It did not take long to discover this fact, and England could then make true calicoes. This soon resulted in a further rescue of the home market from Indian domination. Prints imitative of Indian designs had continued in favor, and these by the production of all cotton fabrics, were greatly improved. Fabrics in the gray, and yarns as well, began to be exported, and Indian textile goods not only ceased to be imported, but in the early years of the present century were called upon to defend themselves from their erstwhile despised competitors. We have, however, pursued the subject far enough to bring out the contrast we desired between then and now.—The Textile Mercury.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Failure of Olive Crop in Southern Europe.—The olive crop in Italy, France, and Spain is practically a failure, says Consul Robert P. Skinner, Consul at Marseilles. As compared with an average crop, it will hardly reach 30 per cent. in the opinion of well-informed judges. In some sections, the fruit is still upon the trees, but enough is known to warrant the expectation of a steady rise in prices. The Italian olives are the greatest sufferers from the pest to which existing conditions are due, the south of France being also affected, and Spain in some localities. The damage has been wrought by a fly known as the Moscaoleraria, which deposits its eggs in the green fruit. A grub is hatched, and this grub destroys the olive, or at least so injures it that the oil is very inferior in quality, and is especially bad for table use.

For some years edible oils have been declining in price, a fair average for fifty years being 38 cents per kilo. of 2·2 pounds. Last year, European oils fell to 19 and 23 cents per kilo., and Tunis oils went to even 15 cents. Prices have so far recovered that good local oil is at 38 cents and Tunis oil at 28 cents. The effect of the shortage upon prices of olive oils for mechanical purposes is well shown by the contract prices arranged for by the French navy. The oils must be pure and pass severe tests. Last year, the contracts ran from $11.96 to $12.54 per 100 kilos. (220 pounds). Contracts for similar oils were let a day or two ago at $19.10 for the same quantity.

In Europe, olive oil is used very generally for the purposes for which lard oil is employed in America. The upward tendency of prices is encouraged by a shortage in the cotton-seed crop in America and a deficient crop of oleaginous grains in Africa and India.

I understand that virtually no effort is made here to counteract the influence of the olive pest. The operations of the insects are regarded as a dispensation of Providence, to be accepted in meekness of spirit. To the lay mind, it would seem that the fly could be successfully fought with American spraying machines, provided an effective chemical combination could be found to put in the water. These flies will be in evidence for some years to come, and appear to be good subjects for American ingenuity and enterprise.

Exports of German and American Bicycles.—Under date of November 29, 1899, Acting Consul J. F. Monaghan, of Chemnitz, reports that the exports of bicycles from Germany during the first nine months of the years 1897, 1898, and 1899 amounted to 8,814,000, 10,554,000, and 10,838,000 marks ($2,097,732, $2,511,852, and $2,579,444) respectively. The principal markets to which the bicycles were exported were Austria, Switzerland, Sweden, Denmark, Russia, Holland, England, Belgium, Norway, Italy, British Colonies, and South America.

The German exporters are satisfied with the foreign bicycle trade when they see that the exports from the United States decreased from $5,473,000 for the first eight months of 1898 to $3,951,000 in the first eight months of 1899. This market, the Germans say, we ourselves have destroyed. In 1897 and the first months of 1898, a great many cheap wheels were put upon the foreign markets, regardless of future business. There were American wheels sold in Germany for 85 marks ($20.23) that were dangerous to ride. They looked well, but that was all. I was told that a firm named Bach & Company, in Buchholz, in Saxony, sold in one year 10,000 wheels any price between 85 and 175 marks ($20.23 and $41.65). The wheels were known as the "Klondyke." It was said that these wheels came from Chicago. It is also claimed that they did more to injure the importation of good American wheels than anything else. Last year, Germany was a strong competitor of England in the latter's home and colonial market. In the first nine months Germany sent to England 11,762 bicycles; to Australia, 2,880; and to British East Indies, 1,452. To meet this competition, the manufacturers of England combined to reduce the price of their wheels. Germans fear that next spring will see large shipments of American wheels to this market.

This market is still open to a large trade in American wheels if certain requirements are complied with; the best possible wheels for the least possible price—not to exceed 250 marks ($59.50) at retail; all broken parts to be replaced in the city in which the machine may be purchased; any tire will answer, but the valves must be like those in vogue here; the law requires a good brake on each wheel, and no wheel should be sent here without one.

American Furniture for South Germany.—Manufacturers of furniture should turn their attention to Bavaria, especially to Munich and its vicinity, as prices charged here, particularly for bird's-eye maple and mahogany veneered bedroom sets, are much higher than in the United States, says Consul James H. Worman, of Munich.

The styles in vogue are so different from those at home that they should be carefully studied. No double beds are wanted, and each set of beds must be matched by a wardrobe (patterns likewise to be carefully studied) and by two night stands, as well as a washstand, which last as here used is about the width of our bureaus or dressers and is supplied with a marble top. Night stands are also so supplied.

Such bedroom sets, without chairs, or with two chairs —usually cane bottomed and to match—retail for about $200 and higher. The bird's-eye maple sets manufactured in Michigan, Western New York, and elsewhere in the United States, made to wholesale with chiffonier and bureau, each supplied with plate-glass mirror, at from $50 to $75, in good quality, could be put here at $100, and be beyond competition if the German taste were first considered by the manufacturers.

Manufacturers of brass and iron beds (single), as well as of cribs, should combine with manufacturers of other household goods and open an exhibition here next year, when the Oberammergau Passion Play and the Bayreuth festival will draw crowds to this section of Bavaria.

Much furniture is brought here from Berlin and other northern German towns. Considerable furniture is also imported from England, France, and Italy, especially parlor furniture, in which the styles do not differ so radically. Undoubtedly, a beginning has already been made in exporting such goods from the United States, but it will pay to send competent men to look over the field for the combined trade, before or after its annual exhibition in New York.

Makers of dining-room furniture cannot hope to succeed unless prepared to exhibit for some time, as the German style of sideboards and extension tables is altogether different, and the general way of fitting up a dining room is dependent upon the use made of the apartment.

An effort is apparent to push American cylinder desks for office and home use, but Germans prefer the open flat-top desk, and manufacturers are losing golden opportunities while attempting to supply what is not wanted. A study of the desks most in use here will soon make this America's market for office furniture.

One house in Berlin is advertising liberally in the papers of Munich and other South German towns and will be rewarded for its enterprise. It seems hardly necessary to emphasize the fact that Munich is the third largest city in Germany, with nearly 500,000 inhabitants and growing about as fast as any American city. It is so situated as to be an excellent distributing point, and should be promptly looked after for present and future trade. Thousands of families are moving into this city, attracted hither even from the Rhenish and other northern provinces because of the artistic advantages, the excellence of the gymnasia and the university, as well as by the fact that Munich has the best water supply and sewerage system in Europe.

Makers of brass lamps also have a good field here. American styles would quickly find favor. The best shops do not offer a lamp worth having for style or finish.

Manufacturers exhibiting at Paris should remember that the middle class of Germans, who are the best buyers, do not go in large numbers far from home.

It is well to consider also that a market made here is a market made elsewhere. Consul Monaghan, of Chemnitz, last September reported an export of rough tables from Germany to the Transvaal amounting in 1897 to 635,140 pounds, and there can hardly be a question that if our makes of furniture were once well introduced on the Continent, and especially in South Germany, the other markets would soon be ours also.

Manual Training in Germany.—On the 1st of October, twenty-four years had elapsed since the movement, having for its object the manual training of boys was inaugurated in Germany, says Consul George Sawter, of Glauchau. In this space of time the idea has certainly been disseminated largely in this empire, and over 2,000 teachers have given their co-operation to the movement; nevertheless, both the internal and the external conditions connected with this new branch of tuition leave much to be desired. The original training in home industries and home occupation has almost entirely disappeared; it is carried on at present only in a few places in Holstein and in 17 institutes for the blind. Most of the other educational establishments in Germany, including 18 orphanages and 46 deaf and dumb institutes, have already introduced manual training into their curriculum. But the endeavor to prepare the pupils in the schools direct for the eventual handicraft has obtained importance in only two of Germany's institutions of learning. The majority of the German home-industry schools only deal pedagogically with the subject.

There exist at present in Germany, distributed in 605 places, 861 schools and institutes wherein manual training is carried on in 1,514 workshops. Of this number, 836 schools and institutes conduct the training on a pedagogical basis. Prussia has 570 manual training schools, spread over 435 places and distributed among 596 workshops. Industrial centers take the lead, as follows: Prussia, Upper Silesia, the Rhenish Province, and the Kingdom of Saxony.

The 1,514 pupils' workshops comprise 286 independent manual training schools and 238 public schools, of which 16 are auxiliary schools where the work is obligatory, 17 middle-class schools, 41 high schools—made up of 8 gymnasiums, 6 technical gymnasiums, 12 technical and technical high schools, and 15 boarding schools, 7 preparatory institutes, 26 teachers' seminaries, and 93 boys' asylums, while the remainder is made up of various kinds of private educational establishments. The organization of the handicraft tuition in the individual schools and institutes is varied in character. Sixty-nine institutes have adopted the whole curriculum as recommended by the German Association for the Dissemination of Manual Skill, while 16 dispense with the preparatory work; of the rest, 177 schools and institutes confine themselves to three branches, 261 limit themselves to two, and the remainder to one branch only. Five hundred and thirty-five workshops are devoted to wood carving, 527 to working in cardboard, and 336 to the carpenter's bench; of these, 68 are closely connected with wood carving, 77 with preparatory roughing-out work, 35 with metal work, 28 with country timbering, 11 with turnery, and 11 with modeling in clay.

Pedagogical manual tuition has branched out in three directions: the practical formal method which regards handicraft as a means to general culture; the direction advocated by those who aim at the so-called school manual dexterity; and the system which would make the manual training serve as the basis of individual branches of teaching and utilize these in order to influence the method of instruction in schools. The first two are becoming more and more amalgamated. In the third direction, Professor Kumpa, at Darmstadt, School Inspector Scherer, at Worms, and Rector Brückmann, at Königsberg, Prussia, are at present engaged in making thorough experiments in public schools.

The participation of German teachers in the efforts of the German association is steadily increasing. Over 2,200 German teachers have up to now been taught to become instructors in manual training. Of these, 950 were taught in Leipzig and 1,250 acquired training in thirty-three places in other parts of Germany.

American Meats in Continental Europe.—Consul Winter, of Annaberg, and Consul-General Guenther, of Frankfort, in reports dated December 7 and 13, respectively, inform the Department that, owing to the competition of American meat on the continent of Europe, an organized effort is about to be made to combat its importation. The Austrian butchers, at their recent meeting, recommended a congress of the butchers of all the states of continental Europe for the purpose of deliberating upon ways and means of counteracting the growth of meat monopolies, protection against imports of unhealthy meat, raising of stock at home, and steps to be taken against American competition. According to German press comments, the butchers of Germany will join those of Austria in almost any kind of an undertaking to keep out American meats. It is stated that the managers of the German Butchers' Association will soon meet for a discussion of the proposition of their Austrian colleagues.

Cable to St. Helena.—Consul Pooley, of St. Helena, on November 23, 1899, writes that the submarine cable from Cape Town has been laid to that point, the steamship "Anglia," with the cable on board, having arrived and the end having been landed the same day at Ruperts, in a valley adjacent to Jamestown. The Consul adds:

The present cable tariff via Cape Town to England is 7s. ($1.70) per word; but on completion of the line the rate will be 4s. (98 cents) direct to England, and I presume an additional shilling (24 cents) to the United States.

Iron Bridge Required at Lourenco Marquez.—The Portuguese Bulletin Commercial is quoted in The Board of Trade Journal, London, January 4, 1900, as advertising for tenders for an iron port bridge 853 feet (260 meters) long and 65½ feet (20 meters) wide, to be built in the port of Lourenço Marquez. Tenders are to be deposited with the general office of the colonies, at Lisbon, by March 23, 1900, 4 p. m.; time allowed for construction, eighteen months; security to be deposited—provisional, 20,000 milreis [the Portuguese milreis is valued by the United States Director of the Mint at $1.08]; definite, 5 per cent. of sum for which contract is awarded.

Tenders for a Railway in the Azores.—According to The Board of Trade Journal, London, January 4, 1900, tenders are invited by the Junta Geral of the district of Ponto Delgada, not later than March 12, 1900, for the construction and working of a railway between the city of Ponto Delgada, the Fumas Valley, and the town of Ribeira Grande.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 634. January 22.—Packing Sugar in Java—Australian Wool Sales—Water Electric Power in Morrisburg, Canada—*Iron Bridge Required at Lourenco Marquez—*Tenders for a Railway in the Azores.

No. 635. January 23.—Brazilian Tariff Changes—*Metric Classification of German Iron Manufactures—*Proposed Free Port at Rotterdam—*American Fruit in Germany.

No. 636. January 24.—Public Improvements in Siam—*Railway Supplies in France—*Land Tax in Kyao-chau—*Custom House at Yao-Chou-Fu.

No. 637. January 25.—Russian Migration to Eastern Siberia—*Advance in Shoe Prices in Germany—*American Meats in Continental Europe.

No. 638. January 26.—Shipbuilding in Germany—New Departure by the British Board of Trade—*Bicycles in Antigua.

No. 639. January 27.—*The Simplon Tunnel—German Textile Factories in the United States—Metal-Paper Trust in Bavaria—Coffee Prices in Brazil—Strikes in Germany.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Cheap Bottle Closure.—Such a medium is afforded by ordinary fine stucco plaster. A small quantity is made into a stiff paste in a cup, and the neck of the bottle is dipped in. The work must be done quickly, because the gypsum hardens promptly. The closure becomes as hard as stone and serves its purpose excellently.—Praktischer Wegweiser.

Ink Adhering to Glass, which renders the troublesome labeling of pharmaceutico-chemical glass-vessels unnecessary, can be prepared as follows: Dissolve 20 grammes of brown resin varnish in 150 c. cm. of alcohol in the cold. To this add drop by drop 35 grammes of borax dissolved in 250 c. cm. of distilled water. A gramme of methyl blue is used for tinting.—Neueste Erfindungen und Erfahrungen.

Polishing Soap for Metals.—Cut 48 kilos of pure grain soap into shreds and melt in the water bath with a little water poured over into the molten substance; stir 6 kilos of finely elutriated chalk, 3 kilos of white lead, 3 kilos of tartar and 3 kilos of burnt magnesia.

These materials must of course be finely elutriated. Mix well by stirring and pour into moulds while still warm, from which the soap is removed after cooling and cut into cubes.—Seifensieder Zeitung.

Black Dye for Tanned Leather.—This receipt takes the place of the ill-smelling iron blacking, and is not injurious to the leather.

Gall nuts, pulverized, 150 grammes, vitriol, green or black, 10 grammes, rock candy 60 grammes, alum 15 grammes, vinegar ¼ liter, cooking salt 1 tablespoonful. Dissolve with 4 liters of distilled water.

Boil this solution slowly and the blacking is done. When it has cooled and settled, pour through linen, thus obtaining a pure good leather blacking.—Neueste Erfindungen und Erfahrungen.

Soap Powder.—1. Oleine (oil) soap 24 kilos, water 30 kilos, ammonia soda (98–100 per cent.) 36 kilos.

2. Oleine soap 20 kilos, Glauber's salt 16 kilos, water 31 kilos, ammonia soda (98–100 per cent.) 23 kilos.

3. Oleine 20 kilos, water 32 kilos, ammonia soda (98-100 per cent.) 35 kilos, soda crystals, lye, 50 kilos.

Oleine and water are put into the kettle, heated over the fire, and the ammonia soda, etc., stirred in in small portions. The thick pulp is taken out and placed on sheet zinc for drying. When perfectly dry, the soap powder is ground into dust in a mill, and filled into packages.—Seifensieder Zeitung.

Repairing Plaster Casts.—Frequently plasterers and moulders are seen to cement broken-off parts of plaster with shellac, and where looks are no consideration, this process may do. In such places, however, where the fracture seam is to be visible, another method should be pursued, such as is practised by sculptors. The fractures are made so wet that they will hardly absorb any more water, hence remain distinctly moist. Meanwhile stir a little gypsum in water very thin and almost "dead," so that it would not bind for itself alone. With this coat the fractures, press firmly together and neatly remove the squeezed-out material. No seam can be noticed after the drying.—Sprechsaal.

Simple and Cheap Air Bath.—This air bath is employed in cases where upon drying or heating of substances acid vapors arise because the walls of the bath are not attacked by them. For the production of the drying apparatus take a flask with the bottom burst off or a bell jar tubulated above. This is placed either upon a sand bath or upon asbestos paper, previously laid upon a piece of sheet iron. The sand bath or the sheet iron is put on a tripod, so that it can be heated by means of a burner placed underneath. The substance to be dried is in a glass or porcelain dish, which is put under the bell jar, and if desired the drying dish may be hung into the tripod. For regulating the temperature the tubulure of the jar is closed with a pierced cork, through whose aperture the thermometer is stuck. In order to permit the forming vapors to escape, the cork is provided with some grooves lengthwise along the periphery.—Centralzeitung für Optik und Mechanik.

Production of Medicinal Wines.—A preparation which corresponds to the specialty known as Vin de Vial is produced from monocalcic phosphate 20, distilled water 20, extract of meat 15, extractum chinae gris 10, sugar sirup 60, Muscatel wine from Samos to 1 liter. The phosphate is dissolved in distilled water, the remaining ingredients in the wine; both solutions are mixed. Macerate for 10 days and filter. Acts as a tonic in anæmia and rhachitis. Dose: One liqueur glass before each meal.

Quinium Labarraque is of the following composition: Quinine 5 grammes, alcohol of 90 per cent. 5 grammes, Muscatel to 1 liter. Dissolve the quinine with moderate heat in the alcohol, mix the alcoholic solution with the wine, and filter after standing for 10 days. Acts as febrifuge, tonic, and digestive. One liqueur-glassful before each meal.

For the production of Quina Laroche is recommended yellow gray and red cinchona bark 10 grammes each, alcohol of 60 per cent. 30 grammes, Muscatel to 1 liter. Acts as antifebrile and tonic. A Madeira-glassful before each meal.—Pharmaceutische Rundschau.

Nickel Steel with Exceedingly Low Expansion.—Guillaume, of the Bureau International des Poids-Mesures, has succeeded in producing an alloy of nickel and steel which is not only interesting from a scientific standpoint, but also valuable in practice. A steel rod, 1,000 millimeters long, expands 1·035 millimeter in heating to 100° C.; in the case of an alloyage with nickel, this expansion increases until it reaches the maximum at 24 per cent. of nickel. From then on, with a greater percentage of nickel, the expansion decreases again, being only 0·0877 mm. in case of an alloy of 35·7 parts nickel and 64·3 parts steel, hence is $\frac{1}{12}$ of that of steel or ⅛ of that of iridium, which heretofore possessed the lowest expansion. If the percentage of nickel rises above 35·7 parts, the expansion becomes larger again. The value of this slight expansion has already been utilized by H. Heele, of Berlin, for astronomical clocks, providing them with nickel steel pendulums instead of the expensive compensation pendulums. For measuring gravity, nickel steel pendulums are used with success. But especially in geodesy, for surveyor's poles and measuring wires, nickel steel is well adapted.—Zeitschrift für Heizungs-, Lüftungs- und Wasserleitungstechnik.

MISCELLANEOUS NOTES.

A new roller boat is being built in Canada, says The Engineer. This vessel is a cigar-shaped craft about 30 feet in length. The screw consists of a cylinder about one-half the length of the boat, situated in the center and passing entirely around the hull proper. This cylinder is supplied with fins or wings running diagonally around from one end to the other, and their rotation gives motion to the hull. The keel, connected at both ends to the hull proper, hangs below the revolving cylinder.

Tellurium is a constituent of the ores of gold, silver, mercury, bismuth and lead, forming with the metallic tellurides. Tellurium is soluble in sulphuric acid, giving a red solution, from which a blackish-gray powder of tellurium is precipitated by diluting in water. Sylvanite is a gold-silver telluride-tellurium 55·8 per cent., gold 28·5 per cent., silver 15·7 per cent. Hessite is a silver telluride. Petzite is hessite with silver partly replaced by gold. Nagyagite is a foliated tellurium in leaves like graphite and contains tellurium, lead, gold, silver, copper and sulphur.—Mining and Scientific Press.

Owing to the growth of the incandescent system of gas lighting in Germany, proposals have been made to reduce greatly the candle power of the gas provided, with a view to cheapening its production. Thus, at Magdeburg, the question has been seriously debated as to whether it would not be well to reduce the candle power from 14, its present value, to 10, and finally to 8. Experiments show that when used with an incandescent mantle, the poor gas has in certain cases given even more light than the rich. Thus, in one series of tests, a burner of this type was supplied with gas ranging in candle power from 15 to 2, and the latter actually gave the best light. Probably it contained a considerable amount of hydrogen. With the recent improvements in water-gas manufacture, a gas rich in this constituent can now be very cheaply produced.

Depressions in the Andean Mountain Crest are noted as follows by Prof. Bailey, of the Harvard observatory at Arequipa, Peru: The known passes between Panama and the Straits of Magellan number 123, with elevations ranging from 2,756 to 16,047 feet above sea-level. There is no pass north of Santiago, Chile, lower than 11,000 feet; and in Bolivia the lowest is that of Huesos, 13,573 feet above the sea. The crossing on the Santiago and Buenos Ayres transcontinental railway is under the Ushallata Pass, 12,700 feet high. It was first proposed to drive an 11-mile tunnel under this pass, but the scheme has been abandoned, owing to the finding of lower and better passes south of Santiago. One at Antuco, 200 miles south, is only 6,890 feet high, and a company has already been formed to build a railway across it, and with it a system of railways connecting Chile with the Argentine Republic.—Engineering News.

The war correspondent of The Daily Telegraph at Modder River described in a message received the other day the process of building the temporary railway bridge across this river. The banks of the river hereabout rise sixty feet above its bed, which necessitated two deep cuttings. The plan of construction was simple. Sleepers were piled up on a bed made of stones. Every ten yards was a pile of sleepers. Resting on these were enormous baulks of timber, on top of which again came the rails. The river is eighty yards wide, and when the engineers commenced their work it was running very fast, but by opening a drain half a mile below the water was considerably reduced, and the stream fell two feet. Day and night for a week exactly did the engineers work, assisted by fatigue parties from the column, and on the eighth day from its commencement the new bridge was declared ready, and, amid the congratulations of everybody, the first train ran across.

Arrow Poison of the Wakamba.—Von Brieger has investigated this heart poison, the action of which closely resembles that of digitalis. Its toxicity is extraordinary, 0·05 mgm. of the pure substance being fatal to guinea pigs of 300 gm. weight, in fifty minutes, while 0·3 mgm. to each kilo. of body weight was fatal to dogs. Analysis points to the formula $C_{29}H_{46}O_{18}$. The active principle crystallizes in anhydrous needles, melting at 182–184° C., but crystals containing 20 per cent. of water separate in larger plates, which melt at 93°–94° C. It is insoluble in ether, acetic ether, chloroform and benzine; soluble with difficulty in cold, more soluble in hot, alcohol or water. The solution is lævogyre. The pure substance does not reduce Fehling's solution. By long heating with mineral acids, a yellow, amorphous, non-poisonous body separates, which is easily soluble in alcohol. The aqueous solution after the removal of this body reduces Fehling's solution, and gives an amorphous glucazone. The glucoside dissolves in concentrated sulphuric acid with a reddish brown color and green fluorescence. With tannic acid and the usual alkaloidal reagents the substance gives no precipitate.—Chem. Zeit. Repert., 23, 315, after Deutsch. med. Wochenschrift.

A series of comparative tests on the holding powers of different kinds of nails was recently completed at Sibley College, Cornell University, and the results are stated thus: 1. Cut nails are superior to wire nails in all positions. 2. The main advantage of the wire nail is due to its possessing a sharp point. 3. If cut nails were pointed they would be 30 per cent. more efficient in direct tension. 4. Wire nails without points have but one-half their ordinary holding power. 5. The surface of the nail should be slightly rough but not barbed; barbing decreases the efficiency of cut nails about 32 per cent. 6. Nails should be wedge-shaped in both directions when there are no special dangers of splitting. 7. The length of nails to be used in tension should be about three times the thickness of the thinnest piece nailed. 8. The relative holding power in different woods is as follows: White pine, 1; yellow pine, 1·5; white oak, 3; chestnut, 1·6; beech, 3·2; sycamore, 2; elm, 2; and laurel, 2·8. 9. Nails usually hold about 50 per cent. more when driven perpendicularly to the grain than when driven along it. 10. Nails are always strongest when driven perpendicularly to the surface of the timber. 11. When subjected to shock, nails will hold less than one-twelfth the dead load they will stand when weight is applied gradually.

SELECTED FORMULÆ.

Rat Poisons.—The substances most useful as rat poisons, and which are without danger to the larger domestic animals, are plaster of Paris and fresh squills. Less dangerous than strychnine and arsenic are the baryta preparations, of which the most valuable is barium carbonate. Like plaster of Paris, this substance, when used for the purpose, must be mixed with sugar and meal or flour, and as a decoy some strong-smelling cheese should be added. In closed places there should be left vessels containing water easily accessible to the creatures.

One advantage over these substances possessed by the squill is that it is greedily eaten by rats and mice. When it is used, however, the same precaution as to water, noted above, is necessary, a circumstance too frequently forgotten. In preparing the squill for this purpose, by the addition of bacon, or fat meat of any kind, the use of a decoy like cheese is unnecessary, as the fats are sufficiently appetizing to the rodents. It is to be noted that only fresh squills should be used for this purpose, as in keeping the bulb the poisonous principle is destroyed, or, at least, is so modified as to seriously injure its value.

THE PREPARATIONS OF SQUILL.

The preparation of the squill as a rat poison can be effected in several different ways. Usually, after the removal of the outer peel, the bulb is cut up into little slices and mixed with milk and flour; these are stirred into a dough or paste, which, with bits of bacon rind, is put into the oven and baked.

Another plan is to grate the squill on a grater and mingle the gratings with mashed, boiled, or roasted potato. This method of preparing them necessitates the immediate use of the poison. The following is, however, a stable preparation that keeps well:

Hog's lard	500 grm.
Acid salicylic	5 "
Squill	1 bulb.
Beef suet	50 to 100 grm.
Barium carbonate	500 "
Solution of ammonium copper acetate 20 per cent.	50 "

Cut or grate the squill into very small pieces, and fry it in the lard and suet until it has acquired a dark brown color and the fats have taken up the characteristic squill odor; then to the mess add the other substances, and stir well together.

PHOSPHORUS POISONS.

Next to the squill in value as a poison comes phosphorus, in the shape of an electuary, or in pills. For readily preparing the electuary, when needed or ordered, it is a good plan to keep on hand a phosphorated sirup, made as follows:

To 200 parts of simple sirup, in a strong flask, add 50 parts of phosphorus and 10 parts of talc powder; place the container in a suitable vessel and surround it with water heated to 120°-130° F., and let it stand until the phosphorus is melted. Now, cork the flask well, tie down the cork, and agitate until the mixture is completely cold. As a measure of precaution, the flask should be wrapped with a cloth.

To make the poison, take 50 parts of rye flour and mix with it 10 parts of powdered sugar. To the mixture add about 40 parts of water and from 30 to 40 of the phosphorated sirup, and mix the mass thoroughly.

While it is best to make the phosphorated sirup fresh every time that it is required, a stable sirup can be made as follows;

Heat together very carefully in a water bath 5 parts of phosphorus, 3 parts of sublimed sulphur, and 30 parts of water, until the phosphorus is completely melted and taken up; then add 30 parts of wheat flour and 6 parts of ground mustard seed, and work up, with the addition of warm water from time to time, if necessary, into a stiff paste, finally adding and working in from 1 to 2 parts of oil of anise.

Borax in powder, it may be noticed, is also useful as a preservative of phosphorated paste or the electuary.

Mühsam gives the following formula for an electuary of phosphorus for this purpose:

Phosphorus, granulated	1 part.
Rye flour	30 "
Simple sirup	10 "
Mustard seed, powdered	1 "
Sublimed sulphur	1 "
Water	10 "

Proceed as indicated above.

Hager's formula for "Phosphorus Globules" is as follows:

Phosphorus, amorphous	10 parts.
Glycerin	20 "
Linseed, powdered	100 "
Meat extract	15 "
Quark, recently coagulated, q. s.	

Mix, and make a mass, and divide into 200 globules, weighing about 15 grains each. Roll in wheat flour, in which a little powdered sugar has been mixed.

Phosphorus electuary, made as indicated above, may be smeared upon bits of fried bacon, which should be tacked firmly to a bit of board or to the floor. It is essential that either flour or sugar, or both, be strewn over the surface of the phosphorus.

The most convenient in practice, on the whole, are the phosphorus globules, either made after Hager's formula, or, more readily, by adding rye flour and sugar to the electuary and working up to a pill mass, or barium carbonate and plaster may be added.

THE STRYCHNINE PREPARATIONS.

The strychnine preparations are also valuable in the destruction of rats and mice. The first of these in point of usefulness is strychnine-wheat, or strychnine-oats (Strychninweizen or Strychninhafer) in the proportion of 1 part of strychnine to 100 or 150 parts of wheat or oat flour, prepared by dissolving 1 gramme of strychnine in 40 to 50 grammes of hot water, mixing well up with the flour, and drying in the water bath. Strychnine may also be used on fresh or salted meat, sausage, etc., by insertion of the powder, or the heads of fried fish are opened and the powder strewn on the inside. The latter is an especially deadly method, since the odor of the fish acts as a powerful lure, as also do the bits of bacon or other fats used in frying fish. Strong cheese is also a good vehicle for strychnine, acting as a powerful lure for the rodents.—Extracts from a paper in the Apotheker Zeitung by A. Roderfeld. Translated for The National Druggist.

KITE METEOROGRAPH CONSTRUCTION AND OPERATION.*

IN designing the kite meteorograph and aerial apparatus employed in making observations, it was necessary to satisfy a number of conditions and limitations, such as, for example, portability, simplicity, strength of construction, uniformity and interchangeability of all parts of the apparatus. The corps of observers, moreover, when they began were without previous experience in kite flying. The entire corps, however, reported at Washington before the individual members were assigned to stations, and were put through a preliminary drilling and course of instruction in practical work. In a short period of ten to twenty days devoted to this instruction, it was possible for the observers to gain only a general knowledge of the apparatus and methods of the work. It was considered best to employ at each ascension only one kite rather than several in tandem, which are very troublesome to set flying in light and fitful winds and are not required, in fact, are less efficient than a single kite in favorable winds. Nearly all of the observations were made with a medium sized kite containing 68 square feet of supporting surface. At some stations a smaller and slightly lighter kite was also sometimes used, according to the state of the wind. The smaller kite contained 45 square feet and the larger 72 square feet. Our first engraving shows the kite with the meteorograph in position. The dimensions of the medium sized kite are as follows: transverse width of kite, 6 feet 6 inches; length over extreme edges fore and aft, 6 feet 2½ inches; distance between top and bottom supporting surface, 2 feet 8 inches; width of cloth bands, 2 feet. These kites are framed and constructed in the most rigid manner possible. The six longitudinal strips running fore and aft are attached by means of small machine screw bolts to the rectangular frames forming the rigid edges to the cloth band and are detachable, thus permitting the kite to be collapsed, as in our second engraving. The best cloth material for kites seems to be Lonsdale cambric, which is light, strong and closely woven. A black or dark colored cloth is more visible, and on many occasions the rear cell was covered with black nainsook on this account. The flying line is attached to the front edge of the forward cell at the middle by means of an appropriate bridle and safety line. The management of the large kites in flight requires a substantial and convenient form of reel of the character indicated in our third engraving. The top portion of the carriage revolves upon the table below on bearings resembling the so-called "fifth wheel" of a wagon. The drum revolves easily in metal bearings and is fitted with dials at the axis indicating the number of revolutions. At the start the dials stand at zero and count off revolutions as the wire unwinds. The lever seen at the right operates a powerful strap iron friction-brake, acting on the rim of the drum and controlling in the easiest and most complete manner the unwinding of a wire or the stoppage of the reel under all circumstances. It is a matter of great importance in the design of the winding drum of the reel to secure sufficient strength in the rim to withstand the enormous accumulative pressure exerted by a large amount of wire wound in under great tension. The rims are calculated to register a crushing pressure of fully a thousand tons. The side flanges of the drum must also be very strong. When flying at elevations from 6,000 to 7,000 feet, one of the Weather Bureau kites supporting its instrument will pull from 60 to 80 pounds, if not more, and from 8,000 to 10,000 feet of wire will be out. To wind all this wire in under such conditions is really a very laborious operation and generally requires two men with pretty hard work from one-half to three-quarters of an hour or more. As sent out to stations the iron reels contain from 2,600 to 3,000 turns of tempered steel music wire 0·028 of an inch in diameter. The normal tensile strength of this wire is about 200 pounds. As the original supply of wire was wound upon each reel, record was kept of the total number of turns, and a table computed giving the number of turns corresponding to the given lengths of the wire in units of 500 feet. Due account is taken in these tables of the gradual diminution in the length of each turn as more and more wire is unwound. The coefficient of diminution was determined from several sets of readings of the revolutions of a measuring wheel around which the wire passed as it was being wound on a reel. Simultaneous readings of the dial on the reel were also made. The measuring wheel was accurately 3 feet in circumference and the dial indicated feet. The wire line employed in flying kites becomes electrified more or less at all times, and often highly so. For the comfort of the operators as well as for safety, each reel stand is provided with an electrical ground connection and switch. The 15-inch cranks by which the reel is revolved are made of wood for the sake of insulation. It is important to know the inclination of the wire at the reel, in order to make a proper allowance for the sag in the wire. This is accomplished by means of a radius rod and the graduated arc, Fig. 3.

The radius rod is clasped loosely upon the axle of the reel on the other side of the drum, and the arc hung over the shaft on a pair of anti-friction wheels which run in a groove turned in a shaft. A weighted rod below the arc causes it to maintain a vertical position at all times, insuring correct angles. In use the radius rod is made to rest against the wire, the angular inclination of which to the horizontal is then shown by the reading upon the graduated arc. This angle is subject to a small and variable inaccuracy due to slight alterations in the radial distance of the wire at the point it leaves the drum, according as more or less of the wire is unwound. The tension upon the line at the reel at any time is determined by means of a dynamometer firmly fastened at the outer end of the handle at the bottom. The short end of the multiplying lever connects with the spring, while the long end serves as an index and traverses a graduated arc shown on the crank handle near the axis. The reading on this graduated arc indicates the pull in pounds on the wire. The outer end of the wire terminates in a small brass eye. When not in use, the reel is covered by a suitable cover, which is locked. The instrument sent up with the kite to secure the automatic record of the conditions of the air is shown in Fig. 1, as it appears attached and inclosed within its light aluminium case. The mechanisms inside the case are shown in Fig. 4, and designed to record wind velocity, temperature, pressure and humidity of the air. Records of the velocity of the wind were made experimentally only at Washington and were not included in the official observations.

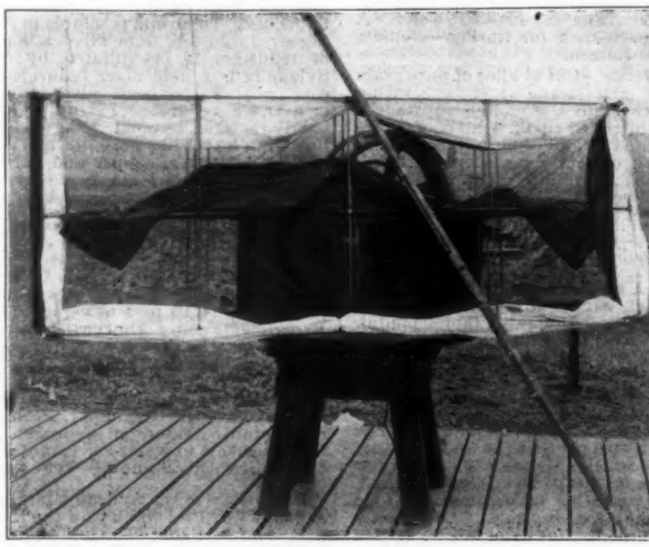


FIG. 2.—KITE COLLAPSED.

When attached to the kite as shown in our first engraving, the meteorograph is so placed that the wind blows with full force directly through the tube containing the thermometer bulb and hygrometer, thus affording a thorough and complete ventilation, radiation being at the same time effectually cut off. Even though the metallic case becomes heated on exposure to sunlight, yet the metal tube is not only raised and exposed to a strong current of wind, but is everywhere separated from contact with the metallic case by vulcanite rings at the ends and longitudinal ivory strips at the sides. Celluloid strips are interposed between the thermometer bulbs and the middle of the inclosing tube, thereby further insulating the thermometer bulbs. These bulbs consist of a pair of tempered steel Bourdon pressure tubes forming a curl of about ⅞ of a complete circle about 1½ inches in diameter. The major and minor axes of the elliptical cross section of the tubes measure approximately 0·5 and 0·1 inch respectively. The tubes are filled with pure alcohol under pressure and are set in tandem and edgewise to the current of the wind through the tube; thus arranged they constitute highly sensitive and relatively powerful thermometric bulbs. The recording pen travels a scale of 22 degrees to the inch, each instrument being adjusted to this scale by tests of different temperatures, the air being driven through the tube by means of an electric fan. The record sheet provides a range of 45 degrees possible change of temperature in any ascension, the initial setting of the thermograph pen

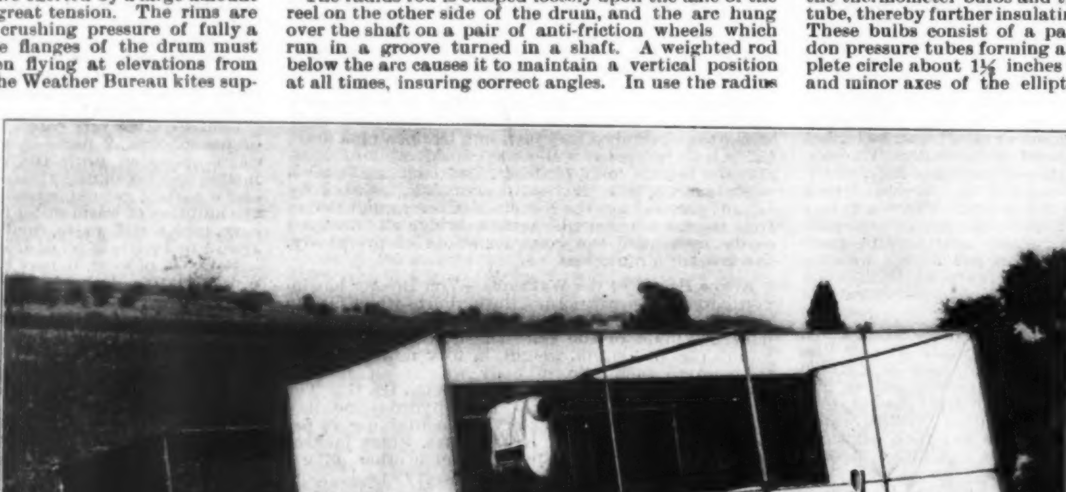


FIG. 1.—KITE WITH METEOROGRAPH IN PLACE.

* Condensed from "Kite Meteorograph Construction and Operation," by Prof. C. F. Marvin, forming part of "Vertical Gradients for Temperature, Humidity and Wind Direction. A Preliminary Report on the Kite Observations of 1898." Prepared by H. C. Frankenfield, Forecast Official, under the direction of Willis L. Moore, Chief of the United States Weather Bureau, to whom we are indebted for our engravings.

being effected by a suitable adjusting screw. The construction of the aneroid barometer will be seen by reference to our fourth engraving. Tempered and highly elastic steel corrugated disks are used instead of brass or German silver. The pressure scale on the record sheet embraces a range of 9 inches, 21 to 30

FIG. 3.—KITE REEL AND SUPPORT.

inches pressure. The subdivisions of the sheet are twenty-two spaces per inch, each representing 0·2 of an inch barometric pressure. Each recording pin is adjustable, and at or before the time of ascension the pens are set as nearly as may be to indicate correctly the atmospheric conditions as shown by readings of the sling psychrometer and mercurial barometer. The instrument is of great interest, and the work which is being done in the way of kite observations is most important.

THE INFLUENCE OF SCHOOL LIFE ON VISION

By PETER A. CALLAN, M.D.

I HAVE been for twenty-five years very much interested in this subject, and was pleased in one way and amused in another by reading a discussion which took place during September at the Twenty-fourth Congress of Public Health in Nuremberg, Germany. The teachers and doctors were pretty well represented in this meeting, and the fourteenth day was devoted to the school physician. The teachers contended that the school physician should look after the eyes, ears, teeth, and nerves of the children. I suppose incidentally they meant infectious and contagious diseases. The doctors were a little more comprehensive. They thought the buildings and equipment for lighting, heating, etc., should be looked after. There was one thing they all agreed on, and that was that the teachers should receive lessons in hygiene. The great point was to educate the public up to the point of knowing what to demand. I hope the question of studies and the excessive amount of unnecessary things which are taught in our schools will be brought up for discussion, for they should to a certain extent be done away with.

The hours for the primary department I think are too long without recess. In the grammar department there is no recess whatever from nine to twelve and one to three.

With regard to my special department, I presume that impaired sight has been more the means of calling the attention of parents, teachers, and physicians to the bad sanitary condition of our schools than anything else. Modern ophthalmology had hardly passed its first decade when the first examination of the eyes of school children was made. That was in the early sixties and, of course, made in Germany, the land of myopia. Every succeeding decade the examiners have been more numerous, and more children have been examined. The results have been tabulated. In 1875 the first examination was made in the United States; since then there have been a great many examinations made. The results have been very uniform. Beginning in the peasant school, it was discovered that there was one per cent. of nearsightedness. This gradually increased in the towns and larger cities until in certain classes in the university as high as seventy-five per cent. of the students were nearsighted. Comment is unnecessary. It may be said with regard to Germany, all old countries are slow to make reforms. They have old school buildings, a miserable type, and then we all must admit that they are excessively hard upon the students. They do a great deal of writing, and their tasks are more severe than in this country.

In 1875 we had separate schools for colored children. I examined five hundred children in all. I found in what corresponded to the high school, the more advanced older children, three per cent. of nearsightedness. In the other school there was over one per cent. Now we all know that nearsightedness is caused by an elongation of the eyeball. We know that confinement and excessive near work cause this elongation. We know further that if such an eye were not forced to do this amount of work, it would not become nearsighted. There are certain children with inherited tendencies who are more prone to this disease than others, and we can truthfully say that nearsightedness is a disease of civilization; that it does not exist among barbarous or savage people; that it is due to abuse of the eye. I selected for example colored children, knowing that neither their parents nor their grandparents had ever enjoyed the luxury of spoiling their eyes which we have nowadays in our modern civilization. Dr. Agnew examined the scholars in the College of the City of New York and found fifty per cent. of myopia in certain classes. These students were, I think, of German or Russo-Polish descent, and some of the other races went as high as twenty-five or thirty per cent.

With regard to myopia, we all admit that it is caused by an excessive amount of work. With regard to the thousand and one ailments, the headaches, sick stomachs, and so on—please do not think I am going to claim everything for the eye, but I do maintain what may be news to you, that there is no such thing as an absolutely perfect eye. Excepting a certain small amount of abnormalities, I may call it the normal eye. Such a normal eye, if tasked too much, with poor light and bad hygienic surroundings, will cause reflex disturbances which will make the scholars very uncomfortable. A perfectly normal eye, such as we regard it, can develop very unpleasant symtoms. I think that our present scholars have too much to do. They have too long hours and not enough recesses. There is no question whatever that there is a depreciation of sight; there are a great many more wearing glasses than formerly—there is more need. Of course, it is not like the good old times that MacKenzie described, where a boy complained of not seeing, and the parents whipped him and the master whipped him, and then he saw.

I hope that the subject of the eyes of the school children and the amount of work will be clearly entered into.—N. Y. Med. Journal.

METEOROLOGY IN THE SCHOOLS.

OCCASIONALLY we are cheered, says The Monthly Weather Review, by discovering an additional enthusiastic voluntary observer and teacher. The following letter from such a one breathes the right spirit and is worthy of record:

Two weeks ago we received notice from the Central Office that if we would contract to keep an unbroken series of observations, the Weather Bureau would establish a voluntary station at our college. Matters were soon arranged so that this would be possible, and the instrument shelter, rain gage, maximum and minimum thermometers, and record blanks have been received. As soon as the shelter can be put in place, we shall begin regular observations. The college has purchased from Friez a barometer, a barometer case, and sling psychrometer, all of which arived on Saturday. The barometer is now hanging in the library, where it can be seen by all, and as soon as our classes in physical geography are well started there will be an intelligent interest taken in this instrument. Last night I explained its general principles to our librarian, who had never seen one before and had no idea of its construction or object.

I find, that in order that this institution may be the general source of broad instruction it ought to be, some one must take hold of those sciences in which I happen to have a general interest. I want this college to be an inspiration to the public school teachers in the State and their central authority for teaching and training in science. Our president feels an interest in meteorology and allied subjects, and we

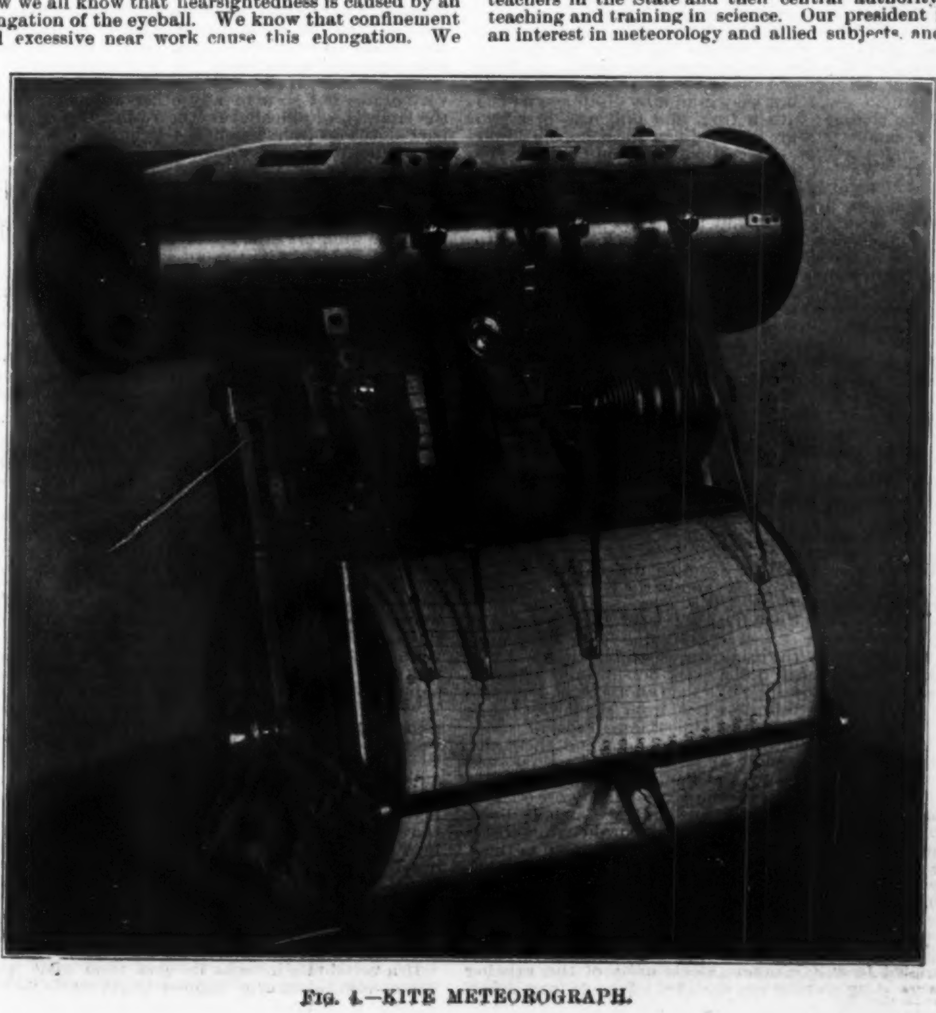


FIG. 4.—KITE METEOROGRAPH.

ought to be able to develop them here. I am introducing more laboratory work into this year's courses, but all our work must be of an elementary character as compared with that of the great universities.

If we science teachers at this place are to make the best of our opportunities to acquire an influence along educational lines, we must struggle against the natural tendency toward narrow sympathies; we must avoid too much specializing; we must give our pupils such instruction as will enable them to take an intelligent, because a practical, interest in all the important lines along which human knowledge is developing to-day. One of the reasons why we endeavored to secure a voluntary station at this college was the conviction that an every-day acquaintance at first hand with the methods, instruments, and phenomena of meteorology will lead our students to acquire a truer and more sympathetic appreciation of the work of the United States Weather Bureau.

The daily map from our State center is displayed on a bulletin board in our front hallway, and in January the State section director is to give us a talk on practical meteorology.

THE EVOLUTION OF THE SEEING EYE.

By William Patten, Professor of Zoology in Dartmouth College.

To the layman it is no doubt something of a mystery how the biologist can feel sure that animals so different from one another as fishes, frogs, or mammals are blood relatives having a common descent from ancestors that must have lived many millions of years ago.

But the methods used by the biologist are very simple. He goes on the assumption that blood relationship and similarity in descent are indicated by similarity in structure.

The scientist, in reading the remote past of the organic kingdom and predicting its future, uses the same method that a boy does when he unhesitatingly identifies a kitten as the offspring of a cat, and, barring accidents, feels sure that it is destined to become a cat and the ancestor of cats. The boy recognizes the kitten because it is like other kittens in color, shape and the proportion of its various parts. But as color, size, and the proportion of parts are extremely variable quantities, the anatomist neglects them altogether when he wishes to determine more remote relationships, as, for instance, the relationship between a fish, a frog, and a dog. He then goes below the surface and looks for similarities in the relative position of one part to another, and in the manner in which they grow and are bound together to form a complete organism.

There are certain structural and mental resemblances between mankind and the apes so obvious as to at once arouse in one the sense of the ludicrous, or of the deepest awe and reverence, according as one's eye is caught by the unexpected resemblances, or pictures to one's self these two organisms as different stages in a line of organic progress that extends downward far beyond the simplest animals and plants into the bottomless abyss of the past, and upward and onward into a future as bright with possibilities for man's progress as was ever imagined.

There are some organs which for some reason or other always appear at certain stages of development, and may remain practically unchanged throughout life; in other animals they are seen for a short time only, or perhaps a mere trace of them appears and then vanishes. For example, every back-boned animal has a series of perforations or slits on either side of the throat, and around these slits, or gill openings, the blood vessels are arranged in a characteristic manner. In all true fishes a stream of water is forced through these openings, which aerates the blood that flows in abundance through the surrounding tissue. In frogs the same gill slits and blood vessels are present during the tadpole stage, but they gradually disappear as the tadpole changes into a frog, and only the first two pairs remain, in a greatly modified form, as the lower jaw and parts of the cartilaginous support for the larynx. We find the same gill slits during the early stages of fœtal life in the throat of human beings, but all except the first two pairs quickly disappear; these remain, as in the frog, and ultimately form the lower jaw and certain cartilages that attach the larynx to the base of the skull. Wherever these gill slits occur, whether in a shark, a frog, a bird, or a human being, they are always situated in the same relative place, and grow in the same way; the blood comes to them from the same sources, passes around them in the same direction, and is finally discharged into the same vessels, whether the animal happens to make use of its gills in respiration or not; and finally each gill-bar, that is the flesh and bone that lie between two adjacent slit, is supplied by a set of nerves arising from exactly the same part of the brain. Every vertebrate animal known has at one time or another just such a set of gill slits, and no other animals, not belonging to the vertebrates, have anything resembling them in these respects. The same thing is seen to be true of almost every other important organ of the body, when we come to analyze its structure and see how it develops in the egg or embryo.

The brain of a fish, for example, differs from that of a human being only in size and in the relative development of its various parts; it is composed of the same elements, the same subdivisions; contains very nearly the same number of nerves, supplying the same organs, and arising from the same corresponding parts of the brain. No animal not a back-boned animal has a brain showing anything like such an arrangement. As we ascend the vertebrate series, from the lowest fishes to man, we find that by an almost imperceptible series of changes, of course fluctuating here and there, the fish brain assumes more and more the characteristics of the higher mammals, and finally of man. The style of architecture changes as the development goes on, and each great group of back-boned animals, such as birds, frogs, turtles, and mammals, has its own characteristic structure, but the anatomist sees the same plan in them all, just as you would recognize your own nine-room Colonial homestead, even though a modern tenant should add a Queen Anne roof or a bow-window here and there. The biologist concludes from such facts as these, that have been worked out with an astonishing amount of care and detail, that all vertebrates have descended from a common stock, most of the existing forms being more or less modified offshoots from different levels along the line of development. Some organs seem to quickly reach their full development and remain practically unchanged through an enormously long line of ancestors, as, for example, the lateral eyes, the two eyes you and I see with; they are called "lateral" to distinguish them from other eyes that perhaps you never heard of, and yet remnants of them are hidden away in your brain and have been in the brains of your remote ancestors for countless generations past. The lateral eyes have come down to us from our fish-like ancestors practically unchanged, except for eyelids and tear glands, and some other parts of minor importance. The coats of the eye, the muscles that move the eyeball, and the nerves that supply them, differ in unimportant respects only from the human eye or from that of any other back-boned animal. Such an eye is of little value to the comparative anatomist for determining relationships within the back-boned animals, because all subdivisions of the vertebrates show very nearly the same peculiarities in the structure of their eyes. The same thing is true of the median eye, just mentioned. This organ has long been known as the pineal gland. It is a conical body about as big as a pea, lying near the center of the brain, deeply covered by overlying folds of the cerebrum and cerebellum. Some of the old philosophers thought it might be the seat of the soul, perhaps because it was situated near the center of the brain, and because it afforded a sufficiently secluded spot within which the soul could hide itself.

But the biologist finally discovered in certain frogs and lizards, where the brain is simpler and its various lobes are smaller, that the pineal gland was situated at the end of a long, hollow stalk just under a semi-transparent spot in the roof of the skull, so that a glimmer of light could fall on the gland. In these animals the organ did not look like a gland, but showed unmistakable evidences of being a rudimentary eye. Since this discovery many students have studied the structure and development of this organ, and we now know that a rudimentary eye like this is present in almost every back-boned animal. It always begins its growth in the young animal as a tubular projection from the roof of a brain chamber, and so constant is its location throughout the vertebrates that it serves as a very valuable landmark by which to identify and locate other parts of the brain. It is doubtful whether it is ever of much value as an eye, even, although it does in some cases have a very respectable lens, optic nerve, and retina. I mean by that if the lateral eye of an animal were destroyed its median eye, even at its best, would hardly do more than enable the animal to respond to a change from light to dark or vice versa. In the great majority of cases it is of no use whatever as an eye. The pineal eye lies underneath the soft spot on the top of a baby's head, and if its nerve were long enough the eye might reach the surface in that region, and not in the middle of the forehead as sometimes represented on the old cyclopean monsters. The Greeks probably drew their inspiration for the creation of these mythical beings not from any knowledge of the pineal eye, but from the observation of rather rare human freaks in which the two median eyes are actually fused into one. If you ever get a good look at a tadpole, you may be able to see a minute whitish spot on top of its head between the eyes. The pineal eye lies under this spot just inside the skull.

Of course, you have already asked why does every backboned animal have such an eye if it is of no use. Different biologists would answer that question in different ways, but most of them would say that such an eye was probably present in the ancestors of the vertebrates, and that for some reason, perhaps because it did not have the right construction or connections, it was finally in part supplanted by the more favorably circumstanced lateral eyes.

There is one remarkable feature about the eyes of vertebrates not seen in any other animals. In both the lateral and pineal eyes, the retina, or the sensitive part of the eye, on which the light acts, is a part of the wall of the brain, which, when the animal is very young, grows out toward the surface of the head so that the light can reach it. Each retina is finally located at the end of a long hollow tube that leads into the cavity of the brain. The tube, which is made of the same kind of tissue as the brain and retina, is ultimately converted into the optic nerve.

As we have already indicated, biologists are agreed that the higher warm-blooded vertebrates are descended from fishes much like those that exist to-day, because there is a really wonderful resemblance in structure between a fish and a human being, the two extreme types in the series; and the younger the human being is, say during the first few weeks of its development within the mother's womb, the more perfect is this resemblance. But when we ask what were the ancestors of the lowest vertebrates, we find that the greatest difference of opinion prevails, and the problem is so difficult that many believe that it will never be solved, because it is probable that the real ancestors have long been extinct, and perhaps have left no trace behind by which their structure can be determined. This, then, is the real gap in our genealogy, and it is more important for the biologist to discover the animals that filled it than those that bridge over the narrow space between man and the apes. Some have thought the ancestors of the vertebrates were like annelida, that is, worms made of a succession of joints or rings, like the earth worms and clam worms; others have assigned this honor to insects, or to the ascidians, and to several other forms, whose names would not mean anything except to a naturalist. If we could only find in any of these animals indications of a hollow brain like that found in all vertebrates, or gill slits, or a primitive backbone, or tubular brain eyes, we would feel pretty confident that animals having such organs were either the ancestors of the vertebrates or very much like them. Now we find that almost without exception the invertebrates, that is all those animals that do not have a backbone, have eyes formed of little pits or depressions in the outer skin, sometimes a comparatively long way off from the brain; and although the retina of an invertebrate and a vertebrate eye is much alike, the latter is always inside out, and arises from the inside of the brain, while the former is right side up and arises from the outer skin of the body.

If a vertebrate inherits its eyes from some invertebrate, how did its eyes happen to get inside its brain? That is not so hard to answer as it may appear. If you examine a frog's egg, or that of a chick or a mouse, you will see that the whole brain and spinal cord is merely a slipper-shaped thickening of the outer skin, like a callous on the palm of your hand, and of course exposed to the direct action of everything that can stimulate the skin. As it grows thicker it is gradually folded into a long tube that quickly sinks out of sight below the surface, without leaving even a scar behind. Now, in some cases, while the brain is still on the surface of the back, we can see the eyes developing out of a part of the skin just as they are in invertebrates, but they are here situated on the very edge of the brain, and when the brain is infolded the eyes are carried down with it, turned inside out, and a little later, at the time when the eyes are first seen by the older observers, they appear to be growing out from the wall of the brain toward the surface of the head. This shows that the eyes of vertebrates were originally derived from the skin, some distance away from the brain, and that they have not always been a part of the brain wall, as they are now.

If we could find some invertebrate whose eyes were in danger of being ingulfed by an ingrowing brain, it might give us some clew to the ancestry of the vertebrates. Indications of such a condition have been found in insects and scorpions, and in the horseshoe crab or king crab we find a very close approach to the vertebrate condition. The king crab has two large eyes on the side of the head, and in the middle three smaller ones about as big as the head of a pin. The extraordinary thing about it is that in the embryo crabs all these eyes lie on the edge of the brain, and as the front part of the brain is infolded the middle eyes are swept in with it, turned inside out, and finally all three of them come to lie at the end of a long tube growing out from the roof of the brain, just as the pineal eye of vertebrates. The lateral eyes barely escape being infolded with them.

But we have always supposed that the pineal eye of vertebrates was a single eye, until recently. But now that its very earliest stages of development have been studied with extreme care in some sharks, we know that it arises from several separate eyes that quickly unite to form what appears to be a single eye. Thus the resemblance between the midian eye of a crab and the pineal eye of vertebrates is made still more striking.

Of course we may not conclude from these facts that vertebrates have descended from king crabs, because the latter are comparatively modern animals that did not appear on the earth till many millions of years after the vertebrate stock was established. But the king crabs are the sole survivors of a very ancient group of spider-like crustacea that did flourish about the time the first vertebrates appeared. They are called trilobites and merostomata; some of them were gigantic fellows, nearly five feet long and having in some respects a decidedly fish-like appearance, so much so that the elder Agassiz mistook some of them for very primitive kinds of vertebrates. Judging from the markings on their shells, they must have had eyes very much like those of the king crab. These facts, together with many others that we cannot explain here, furnish very strong evidence that these ancient crabs are the long lost ancestors of the vertebrates.

Such a study as we have outlined will serve to show how the biologist makes use of the structure and growth of various organs to read the history of the remote past; it also illustrates the way in which some organs are handed down with a wonderful persistency through countless generations, long after they have passed their period of usefulness.—N. Y. Times.

AN IMPORTANT PATENT DECISION.

By Arthur F. Kinnan.

An unusually important decision has just been rendered by the United States Court of Appeals for the District of Columbia, in the case of Bechman vs. Wood. As the decisions of this court do not appear in any of the court reports, a critical analysis of the decision will be of more than passing interest to persons interested in patents.

The state of facts upon which the decision is based is as follows:

Wood filed an application for a patent, presenting therewith a claim of invention limited in its scope. Two years later Bechman filed an application for a patent disclosing a machine which, while it was specifically different from Wood's, accomplished the same result in an equivalent manner, and accompanied his application with a claim of invention so broad in its scope as to read equally well on Wood's device. A year after Bechman's application was filed, Wood made a claim similar to Bechman's. A contest was instituted in the Patent Office to determine which party should be allowed to have the broad claim in his patent. All the tribunals of the Patent Office having jurisdiction of the contest successively decided that Wood was the first inventor and therefore entitled to the broad claim in controversy. Thereupon Bechman appealed to the Court of Appeals.

The court found no difficulty in deciding with the Patent Office that Wood was the first inventor, but made the novel holding that neither party was entitled to the broad claim in issue—holding that Bechman could not have it, for Wood invented its subject-matter first; and that Wood could not have it because he did not present the claim until after Bechman had presented it.

It is common practice for the defeated party in a contest for a broad claim of invention to oppose in every possible way the granting of a patent containing the broad claim to the successful party. When a party has lost, he usually pleads that his own device does not fall within the terms of the claim, or that the successful party has no right to make the claim, or that the claim is not patentable. All these pleas were made by Bechman and were overruled.

The reason advanced by the court for denying the broad claim to the first inventor, viz., that he did not claim it in his application until after the later inventor had done so, was not hinted at even remotely by counsel for Bechman, and was never before presented in any reported case. The court on its own motion went outside the matters presented by counsel and based its reasoning on the well known and leading cases of Railway Co. vs. Sayles, 97 U. S., 554, and Topliff vs.

Topliff, 146 U. S., 156, and which cases were not cited in the brief of either party.

A motion for rehearing was heard, and in view of the importance of the case, the court allowed the Commissioner of Patents, through his law clerk, and a prominent patent lawyer, as amicus curiae, to file briefs in opposition to the decision.

The cause of the errors of the court was not pointed out nor touched upon in any of the briefs or arguments, which were confined to an attack upon the errors themselves, with the result that the court, not having had the reasons for its errors disclosed, sustained its former ruling.

The real cause of the errors is to be found in the fact that the court of its own motion invaded a field of special law without the aid or enlightenment of counsel skilled in the technicalities of such law. To words which have acquired peculiar and special significance in the law of patents, the court gave their ordinary and popular meaning, and thereby came to a conclusion which is unprecedented, inequitable and in violation of the federal patent laws. The finding of the court was a clear and logical deduction from the Supreme Court decisions cited by it in support of its position when it had in mind the language of the decisions as such language is frequently or commonly used.

The court reasoned, first, that Wood was estopped from making his broad claim because of the "intervening right" of Bechman, Bechman having made the claim first; and second, that it was not competent for Wood, having at first made a narrow claim, to "enlarge his original specification to interfere with other inventors who have entered the field in the meantime." It therefore decided that Wood, although the first inventor, could not have the claim.

The first error of the court in holding that Bechman had an "intervening right," arose by reason of the court confusing a mere application for a patent with the patent itself, which confusion has been before known to occur in federal courts.

The "rights" of an inventor are purely statutory. He therefore has no "rights" whatever in his invention other than the statutes give him. The Revised Statutes provide (Sec. 4886) that, under certain conditions, if a person has made an invention, and will properly describe it (Sec. 4888) so that the public can reproduce it, and properly claim it, so that the public may know exactly what parts of all that which is disclosed they are not free to use, the Government will then grant him a right, and make that right patent by publishing it under the seal of the United States. An inventor's rights begin only with the date of his patent. He cannot treat any act that occurs before that date as an infringement of his rights.

An application for a patent is no more and no less than a mere secret preliminary proceeding between two parties to a future contract, the Government offering to grant a monopoly for seventeen years in exchange for a new invention properly described and claimed. No "rights" accrue to either party until the contract is signed, sealed and delivered. The moment an application for a patent is filed, a discussion at once arises as to the terms of the future contract, i. e., as to the breadth or scope of the claims. The only limitations that can be placed upon the inventor are that his invention must be clearly described, and that his claims must be patentable and must read on his invention as he disclosed it to the Government when he filed his application. It is perfectly immaterial at what time during the progress of the discussion of the future contract the applicant presents a claim commensurate with his invention, or what induced him to present it. If his claim reads on his invention, it will be allowed to him, to form a part of his "rights" when it appears in his patent.

Congress anticipated the fact that two or more persons might make claim to the same invention and provided (Sec. 4904) that under such conditions a contest should be instituted and a patent awarded only to the first inventor. This was the case with Wood and Bechman. Wood proved priority, and under the law should have had the claim. When Bechman filed his claim, he had no right to it whatever. He took his chances on its being patentable and on his being the first inventor of it, and was merely asking the Government if it would, at some time in the future, give him the right to it; i. e., give him a patent containing that claim.

The court in speaking of the "intervening rights" of Bechman cites Topliff vs. Topliff and other leading decisions, all of which relate to the reissue of patents, and which cover an entirely different state of facts, and are governed by totally distinct and independent statutes.

The "intervening rights" alluded to in the Supreme Court decisions all refer to rights which the public has acquired between the time of the granting of a patent and the time of the granting of a reissue of the patent.

When a patent is granted, the contract signed, sealed and delivered, it is published to the world with presumptive notice that the people in the United States are not to infringe the claims thereof. Any person is obviously at perfect liberty, as far as that patent is concerned, to make, use and vend anything that is disclosed in the patent but not claimed therein. Sec. 4916 provides that a patent may be surrendered and reissued if some mistake was inadvertently committed in issuing the original patent. The Supreme Court has uniformly held, however, in the decisions cited by this court, that a patent cannot be reissued to include matter not within the scope of the claims of the patent, if the public on seing the patent and before the reissue was granted had availed itself of the matter not claimed. This use by the public, or a single member of it, of matter disclosed but not claimed in a patent, if such use occurred before the patent is reissued, is in patent law technically called "intervening rights." When a patent is granted and published to the world, the public has, under the statutes, a right of way, as it were, across the patent, provided it keeps outside of the boundaries fixed by the claims. If the patentee discovers that the boundaries have been inadvertently improperly fixed, he may surrender his patent and get a reissue in which the boundaries are correctly established, provided always that he changes the boundaries before the public has actually occupied its right of way, or before the rights of the public have intervened.

The court in its decision has simply used the language of the Supreme Court in discussing the "intervening rights" of the public to matter not claimed in a patent, and has applied that language to an application for a patent without any change, adaptation, or reasoning to show any analogy between the two. It has taken language which very properly applies to a public patent with its boundaries fixed and its rights established, and defined by certain laws, and has applied that language to a secret request for a patent, and in which request the boundaries shift like the sands of the sea up to the very moment of a final granting of the request, and which request is prosecuted under other and totally dissimilar statutes.

Bechman and Wood, under the statutes, possess no rights of any kind, but are mere claimants for the grant of a future right and are before the government for the very purpose of having the boundaries of their claims settled before a right is granted to either of them. To apply to their cases, which are in a chaotic condition up to the time their patents are issued, the laws which control the relations which exist between a patent and the public is obviously an error, and that is exactly what the court did, and did it in the face of the dicta in its own decision in the case of Christensen vs. Noyes, 90 O. G., 227, decided a month prior to the decision under discussion, and in which it said "while Congress has prescribed the mode by which the exclusive right of an inventor in his invention may be secured, yet there is no property right in such invention until a patent be issued therefor."

Turning now to the second ground advanced by the court for refusing the claim in issue to Wood, although he is the first inventor, the court quoting Railway vs. Sayles holds that it is not competent for Wood, having first made a narrow claim, to enlarge his original specification to interfere with other inventors who have entered the field in the meantime. Here the court has given the words "enlarged his original specification" their commonly accepted meaning, when after decades of use in the patent law these words have come to have a special and unusual significance.

When an inventor files with the government his request for a patent, the only limitations which under the statutes can be imposed on him are, that the invention must be patentable, that it must be fully described and that it must be properly claimed. An inventor does not invent a claim, but he invents a thing. The claim is merely a statement in language of what the inventor considers the novelty in the thing to be, and the claim will be varied in scope as circumstances demand, to correspond with what the government and the inventor shall agree is actually novel. If he has invented something totally new, he may claim "means" for accomplishing the desired end, and if a patent is granted to him, he can treat as an infringement of his patent right any other means which accomplishes the same result in a substantially equivalent manner. The language of his claim can obviously be as broad as his actual invention, and is only limited by it. He cannot under any conditions extend his claim beyond his invention. It has, therefore, been the universal and just practice of the Patent Office and of the courts, of which the case of Railway Co. vs. Sayles is a leading case, to hold an inventor's actual invention to be fully disclosed when he first files his application, and thereafter to permit him only to amend one part thereof by another. If his drawing clearly shows a feature not described and claimed, he may, under proper oath, amend his specification to describe and claim it. Or if a feature is clearly described but not illustrated or claimed, he may in like manner illustrate and claim it. But when the patent issues, every claim must cover no more than was originally disclosed in the application as first filed. If any matter not originally disclosed, however trivial, has been inserted in the description and included in the claim, the specification is known in patent law parlance as "an expanded specification," and the claim is very properly declared to be invalid. An inventor, if allowed to introduce matter into his application which he had not originally disclosed, could on seeing some improvement on his machine made by another, at once amend his application to interfere with the rights of the public or with the rights of another party, which he could not do if he were permitted to only claim what he originally disclosed. Whether the application is the first or original application or whether it is an application for a reissue, the same rule holds, the claim must not be broader than the invention originally disclosed, the specifications must not be "expanded." The facts which form the basis of the rule are perfectly apparent upon a careful reading of the decisions referred to by the court in deciding this case, and the rule cannot by any legitimate construction be applied to a claim which reads directly on the invention as first disclosed. The court has, however, applied the term "expanded specification" to Wood's case when Wood has merely made a claim in his application commensurate with his exact invention as it was fully and originally disclosed, exactly as the statute requires him to do.

The court has clearly made a decision in this case which is not supported by law or countenanced by equity, and as it is an appellate court of last resort it places Wood in a most peculiar situation. He has no appeal. A motion for a rehearing has been denied. He has made an invention and been decided to be the first inventor, but is denied a claim to his invention which the statute says he must make, first, on the ground of the "intervening rights" of the other party, when the other party has no rights whatever; and second, on the ground that his "specification was expanded," when his specification contained nothing but what was originally disclosed. If the Supreme Court of the United States will not grant a writ of certiorari, Wood's remedy is by a bill in equity (Sec. 4915), an expensive and arduous undertaking, but apparently the only one available.—Electrical World and Engineer.

OYSTER CULTURE IN FRANCE.

ARTIFICIAL culture has for some time been largely depended upon in Europe and America for a supply of oysters. The chief breeding ground in France is the Bassin d'Arcachon, a triangular tidal bay about nine miles on each side, entirely land-locked and opening out of the Bay of Biscay into the Department of the Gironde by a narrow channel about three miles in length. The coast is sandy and deserted. A solid forest of pines, planted during the present century, has checked the inland march of the sand dunes, and protects the basin from the southwest winds which blow fifty out of the fifty-two weeks of the year. According to the United States consul at Bordeaux, the shallow bay is networked with navigable channels, between which at low tide rise the half clay, half sand flats utilized for breeding the mollusk. During the low spring tides the flats are covered with quantities of a cheap variety of ordinary roofing tile, which has been previously coated with a sort of coarse whitewash. The spawn brought in by high water catches on these tiles, and the lime of the whitewash helps the little mollusk to form his first shell. Toward winter these tiles are taken up and carefully scraped. The oysters, as large now as one's thumb nail, are spread in flat-covered trays or baskets of closely woven osier to protect them from the starfish, crabs, and other enemies, and moved nearer the salt marshes on the east side of the basin to grow. When they have become a little accustomed to an independent existence, they are placed in trenches a little below water level, which are provided with sluice gates, by which they can be flooded at will. They are thus prevented from being chilled in winter or dried up in summer, and are easily protected from enemies, the gates being covered with wire netting of fine mesh, but the primary object of the gates is to accustom them to being deprived of water—that is, teach them to keep their valves tightly closed when out of it. In about eighteen months their education in that respect is complete, and they are raked up, placed in barrels, and sent on a journey of several days to Marennes and other places to fatten and assume the green tint and delicate flavor demanded by European epicures. About 250,000,000 are shipped annually. The work on the beds is done by barefooted men and women, both clad in bright crimson knee breeches and vests, which render the sexes quite undistinguishable. The regular trenches and dikes, kept in place with spikes interlaced with wattles, look like a Dutch garden.—Journal of the Society of Arts.

THE EGG-CARRYING HABIT OF ZAITHA.

By FLORENCE WELLS SLATER.

IT is a well-known fact that certain bugs of the family Belostomidæ carry their eggs on their backs until they are hatched. This has been frequently observed in the case of Zaitha fluminea, which is common in the Atlantic States, and with Serphus dilatatus of the Western States.

It has been taken for granted by all who have described this habit that it is the female that carries the eggs. And Dimmock even states*: "These eggs are nicely set upon one end, and placed in transverse rows, by means of a long protrusile tube, or ovipositor, which the insect can extend far over her own back." Investigation proves, however, that, in the case of Zaitha at least, the credit of carrying the eggs belongs to the male, and that the ovipositor of the female is so short as to make it impossible for her to reach her back with it.

In the course of a study of the reproductive organs and genital armature of Zaitha, made in the entomological laboratory of Cornell University, I have had occasion to dissect many egg-bearing individuals, and in every case they have proved to be male.

The specimens used were collected in the vicinity of Ithaca, where the species is abundant in ponds; and as the egg-laying season lasts from June until the latter part of August, it was easy to obtain material for study. The insects were found most abundant in shallow water, quite near the shore, clinging to the underside of aquatic plants, especially Marsilia.

The eggs of Zaitha are very large as compared with those of other insects. They number from seventy-five to eighty-five and are placed in regular diagonal rows on the upper side of the wings of the male. This makes a heavy load for the male to carry and also deprives him of the use of his wings, confining him to one pond.

That the male chafes under the burden is unmistakable; in fact, my suspicions as to the sex of the egg-carrier were first aroused by watching one in an aquarium, which was trying to free itself from its load of eggs, an exhibition of a lack of maternal interest not to be expected in a female carrying her own eggs. Generally the Zaithas are very active, darting about with great rapidity; but an egg-bearer remains quietly clinging to a leaf with the end of the abdomen just out of the water. If attacked, he meekly receives the blows, seemingly preferring death, which in several cases was the result, to the indignity of carrying and caring for the eggs.

At other times paternal instinct seems to predominate, for with the third pair of legs, which are covered with long hairs, he brushes the eggs carefully to free them from foreign particles. Oftener, however, he vigorously kicks and pushes the eggs. In this way several of the males in my aquarium were successful in dislodging the eggs in a mass; then the hitherto meek, morbid Zaitha darted hither and thither with great rapidity, as if intent upon exhibiting to all the community his regained liberty.

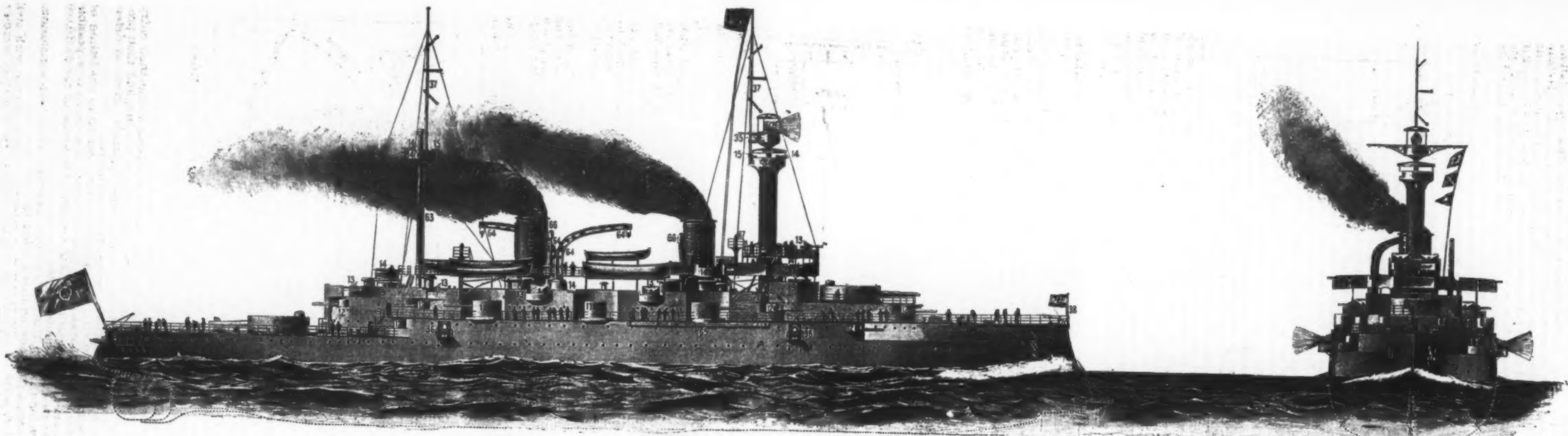
The female is a trifle larger in size than the male and has two small hairy papillæ on the flap covering the genital armature; these are the only external characters which distinguish her from the male.

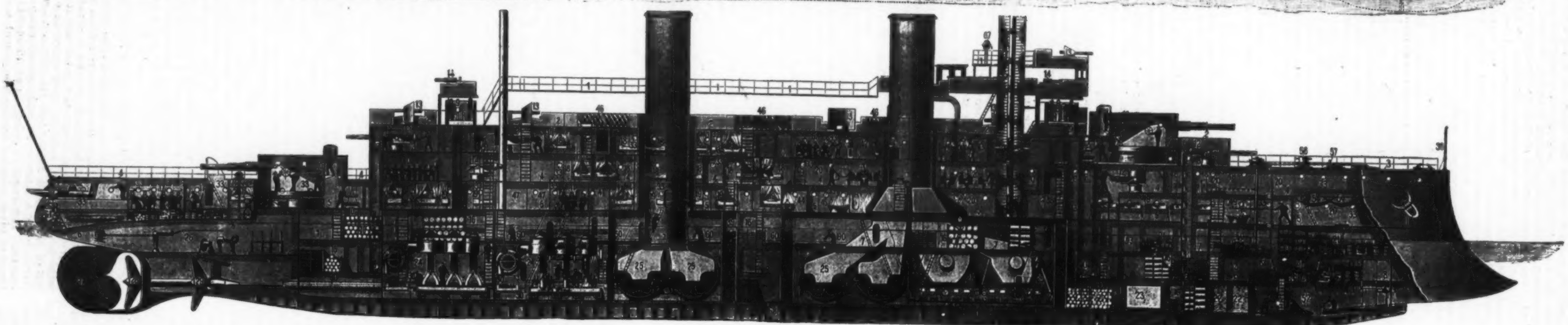
My observations indicate that the female is obliged to capture the male in order to deposit the eggs. Upon visiting the aquarium one afternoon a male was found to have a few eggs upon the caudal end of the wings. There was a marked difference in the color of these, those nearest the head being yellow, while those nearest the caudal end were dark gray. The small number of the eggs indicated that the female had been interrupted in her egg-laying, and the difference in color of the eggs, that the process must be a slow one.

For five hours I watched a silent, unremitting struggle between the male and the female. Her desire was evidently to capture him uninjured. She crept quietly to within a few inches of him and there remained immovable for half an hour. Suddenly she sprang toward him; but he was on the lookout and fought so vigorously that she was obliged to retreat.

After this repulse she swam about carelessly for a time, as if searching for food was her only thought.

* Annual Report of the Fish and Game Commissioners of Massachusetts, 1886, p. 71.

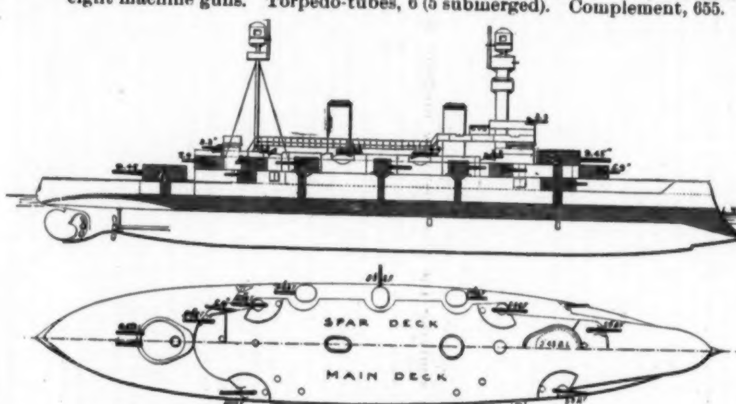




THE GERMAN FIRST-CLASS BATTLESHIP "KAISER FRIEDRICH III."

Displacement, 11,130 tons. Speed, 18 knots. Coal-carrying capacity, 650 tons. Armor: Belt, 11¾ inches; gun positions, 9¾ to 6 inches; deck, 3 inches. Armament, four 9·4-inch, eighteen 5·9-inch, twelve 3·3-inch rapid-fire guns, eight machine guns. Torpedo-tubes, 6 (5 submerged). Complement, 655.

1. Bridge.
2. Superstructure deck.
3. Spar deck.
4. Main deck.
5. Armored or berth deck.
6. Curved armored deck.
7. Orlop deck.
8. Platform deck.
9. Conning-towers.
10. Turrets for main battery.
11. Turrets for secondary battery (5·9-inch guns).
12. Armored casemates for 5·9-inch guns.
13. 3·3-inch guns with shields.
14. 1·45-inch machine-guns.
15. 0·3-inch machine-guns.
16. Magazines.
17. Commander's quarters.
18. Officers' quarters.
19. Deck officers' quarters.
20. Crew's quarters.
21. Store-rooms.
22. Drinking-water tanks.
23. Refrigerating room.
24. Engine room.
25. Boiler room.
26. Steering-engine room.
27. Rudder.
28. Central screw-propeller.
29. Side screw-propeller.
30. Propeller-shaft.
31. Hawse hole.
32. Ram.
33. Portholes.
34. Fighting-top.
35. Searchlight-top.
36. Searchlights on movable platforms.



"KAISER FRIEDRICH III."—CLASS OF FOUR BATTLESHIPS.

37. Signal masts.
38. Jack-staff.
39. Coal bunkers.
40. Cadets' mess room.
41. Junior engineers' mess room and pantry.
42. Officers' galley.
43. Crew's galley.
44. Deck officers' bath room.
45. Stokers' bath room.
46. Hammock-netting.
47. Cadets' wash rooms.
48. Head.
49. Hospital with wards and bath room.
50. Capstan-engine.
51. Chain-lockers.
52. Forward torpedo room.
53. Boatswain and carpenter's store rooms.
54. Hammocks.
55. Mast with winding stairs to tops.
56. Bits for belaying anchor-cable.
57. Cable-stopper.
58. Officers' mess room.
59. Clothes lockers (in crew's quarters).
60. Main steam-pipe.
61. Cofferdam filled with cork.
62. After torpedo room.
63. Ladder for ascending to after fighting top.
64. Boat-cranes.
65. Swinging booms for fastening boats.
66. Galley chimney.
67. Compass.
68. Double bottom.

But in ten or fifteen minutes she was back in her first position in front of him. Again there was the attack, and again the repulse. The same tactics were continued until midnight, when, despairing of her success, I left them.

At six o'clock the next morning the entire abdomen of the male and half of the thorax were covered with eggs. Those nearest the head were quite yellow, showing that the struggle had just ended.—American Naturalist.

GERMANY'S LATEST BATTLESHIP.

THE accompanying sectional view of the German first-class battleship "Kaiser Friedrich III." will give our readers a clear impression of the wonderful amount of detail that enters into the make-up of a modern warship, and to those of them who like to have something more than a general knowledge of the subject the diagram, with its very complete descriptive tables, will be found useful for future reference in connection with articles descriptive of our own warships or those of other navies.

The Germans, in the design of ships of their new navy, have shown marked originality, and there are some respects in which their vessels are superior to those of most other navies. The conspicuous feature is the admirable distribution which has been made of the numerous armament of the "Kaiser Friedrich III." It is generally agreed among naval designers that the separate units which make up the total armament of a warship can not be too widely separated. The terrific powers of destruction of a bursting shell make it desirable to localize its effects as far as possible, and this feature is well worked out in the German ship. The thirty-four guns in the main battery are distributed upon four decks, and the guns upon any one deck are widely separated from each other. Moreover, the guns are all carried either in complete turrets or in separate armored casemates.

Another excellent feature of the vessel is, that every gun is of the rapid-fire pattern, not even excluding the four heavy armor-piercing guns of the main battery. A third feature in which the ship is thoroughly up-to-date is the comparatively small size of the heaviest guns, the largest of which are only 9·49 inches caliber. The use of such light guns means a great saving in dead weight and a proportionate increase in the fighting qualities of the ship in the way of more speed, larger coal capacity, or a more numerous armament.

The "Kaiser Friedrich III." has the moderate displacement of 11,130 tons, which is 1,000 tons less than that of the Japanese battleship "Fugi," over 2,000 tons less than our latest battleships of the "New Jersey" type, and the "Majestic," of the British navy, exceeds it by 3,700 tons.

It is probable, however, that Germany intends to use these battleships more for coast line defense than for foreign service. The "Kaiser Friedrich III." would have to be increased in displacement by from 1,200 to 1,500 tons, if she were to carry the coal, ammunition, and stores sufficient for an extended service during war times in far distant waters.

In studying the accompanying diagram, it will be seen that the guns of this vessel are to be carried at four different stages of elevation above the water. The lowest guns are two 9·4-inch rapid-fire guns in the after turret on the main deck, and the four 5·9-inch, which are carried in casemates, two forward and two aft, on the same deck. On the spar deck above are mounted fourteen 5·9-inch guns. Six of these are carried in one-gun turrets on the broadside and eight in casemates, four forward and four aft. Forward in a turret, on the superstructure deck, and at a height of over 30 feet above the water, is the forward pair of 9·4-inch rapid-fire rifles, and, at the same elevation, on the superstructure deck, are ten 3·3-inch rapid-fire guns. Above these again, at a height of 46 feet above the water line, on the upper bridge, is a pair of 3·3-inch rapid-fire guns. The all-around fire which is aimed at in this distribution is unusually powerful. The vessel can concentrate two 9·4-inch, eight 5·9-inch, and six 3·3-inch rapid-fire guns ahead; four 9·4-inch, nine 5·9-inch, and six 3·3-inch on either beam; and two 9·4-inch, eight 5·9 inch and four 3·3-inch astern. The armor on belt is 11¾ inches amidships, tapering to 6 inches at the ends. The main turrets carry 9¾ inches of armor and the casemates 6 inches. It will be noticed that the vessel is driven by triple screws, an arrangement which has been found to give excellent results in our own "Minneapolis" and "Columbia."

In studying the longitudinal section of the "Kaiser Friedrich III.," our readers will notice that the thick armored deck, No. 5, in the descriptive table, divides the vessel vertically, the most vulnerable portion of the ship, that is, the boilers, engines, magazine and steering gear, all of which are commonly known as the "vitals," lying beneath the armored deck and below water line. They are known as vitals because a shell bursting among them might easily put the ship out of action, and it is absolutely imperative that this portion of the vessel should be secure against attack. The thick armored belt at the water line, the cellulose or, as in this case, cork protection, also at the water line (see No. 61), the complete armored deck, and the fact that these vitals are well below the water line render the chances of a shell entering the vitals very remote.

Above the armored deck are the guns and the living quarters for the officers and crew. At the extreme after end of the vessel are the quarters of the commander, captain or admiral. The officers' quarters are situated on the afterpart of the main deck and spar deck, while the crew's quarters are to be found on the same deck forward of the center line of the ship.

The weakest point of this type of ship is found in the scanty protection afforded to the ammunition in its passage from the magazine to the guns, and in the lack of armored protection for the bases of the turrets. In the case of a ship like our own "Maine," there is a continuous wall of armor from the water line to the top of the turrets; but in the "Kaiser Friedrich III." (see diagram) the only connection is a small ammunition tube. In a fight at close range the endurance of the "Maine" would be considerably greater than that of the German ship.

It is stated that the new French naval programme includes thirty-four submergible boats.

ABSTRACT OF THE REPORT OF THE COMMITTEE ON CANALS OF NEW YORK STATE.

NEW YORK, January 15, 1900.

Hon. THEODORE ROOSEVELT, Governor of New York:

SIR: The undersigned have carefully considered "the broad question of the proper policy which the State of New York should pursue in canal matters," as requested in your letter to us of March 8, 1899, and have reached the following conclusions:

First: That the canals connecting the Hudson River with Lakes Erie, Ontario, and Champlain should not be abandoned, but should be maintained and enlarged; and that the Black River and the Cayuga and Seneca Canals should be maintained as navigable feeders, but that they should not be enlarged at the present time.

Second: That the project of a ship canal to enable vessels to pass from the upper lakes to New York city (or beyond) without breaking bulk is a proper subject for consideration by the Federal government, but not by the State of New York.

Third: That the project of 1895 for the enlargement of the Oswego and Champlain Canals should be completed at a cost of $2,642,120.

That there are two projects for the enlargement of the Erie Canal which should be considered by the State of New York.

The first is to complete the project undertaken in 1895, with certain modifications, to wit:

The deepening of the prism to 9 feet throughout and the lengthening of the locks on one tier so as to pass two boats, each 125 feet in length, 17½ feet in width, and 8 feet in draught, with a cargo capacity of about 450 tons each, and the lengthening of the locks on the other tier so as to pass a single boat of the same size;

The use of pneumatic locks, or other mechanical lifts, at Cohoes and Lockport, and new locks at Newark and Little Falls, by which twenty-one locks will be eliminated;

The construction of a new canal from near Clyde to near New London—about 81 miles in length—giving a wide waterway throughout the Seneca and Oneida Rivers and Oneida Lake, and avoiding the Montezuma marshes;

The abolition of the two aqueducts across the Mohawk River and the substitution of the river for the canal from Cohoes to Rexford Flats, near Schenectady, and possibly as far as Little Falls;

The construction of a new canal from the foot of the falls of the Mohawk, near Cohoes, to the Hudson River, near the West Troy side cut.

The estimated cost of this project is $21,161,645.

The second project is to construct a canal along the some route as above named, but of sufficient size to carry boats 150 feet in length, 25 feet in width, and 10 feet draught, with a cargo capacity of approximately 1,000 tons each. The prism of such canal to be not less than 12 feet deep throughout, with not less than 11 feet of water in the locks, and over all structures, and the locks to be about 310 feet long and 28 feet wide, so as to pass two boats at one lockage. Such a canal will be capable of carrying a tonnage equal to the capacity of the St. Lawrence canals.

The estimated cost of this project is $58,894,668.

In our judgment, arrived at after long consideration, and with some reluctance, the State should undertake the larger project on the ground that the smaller one is at best a temporary makeshift, and that the larger project will permanently secure the commercial supremacy of New York, and that this can be assured by no other means.

We believe our estimates of cost to be adequate for submitting this proposition to the voters at the election in November next, and in the meantime we advise that the legislature make an appropriation of $20,000 to be immediately available for surveys, so that the detailed surveys, which are indispensable to the proper making of contracts, could be completed during the present year. If the proposition is approved by the people in 1900, the work can be completed, if properly managed, so as to be available for the season of 1905.

Fourth: That the money to pay for these improvements should be raised by the issue of eighteen-year bonds in the manner prescribed by the State Constitution, and that the interest and principal of these bonds should be paid out of taxes specifically levied, for benefits received, in the counties bordering in whole or in part on the canals, the Hudson River, and Lake Champlain; such taxes to be levied in proportion to the assessed valuation of the real and personal estate in such counties. These taxes will amount to about 10 cents per $100 of assessed valuation annually during the period of eighteen years.

Fifth: That the efficiency of the canals depends upon their management quite as much as upon their physical size, and that no money should be spent for further enlargement unless accompanied by measures which will accomplish the following results:

(a) The removal of all restrictions as to the amount of capital of companies engaged in transportation on the canals, and the encouragement of large transportation lines for handling canal business, in place of hampering them, as has hitherto been the case.

(b) The use of mechanical means of traction, either steam or electricity, in place of draught animals; and the use of mechanical power in place of hand power for operating the gates and valves, and moving boats in locks.

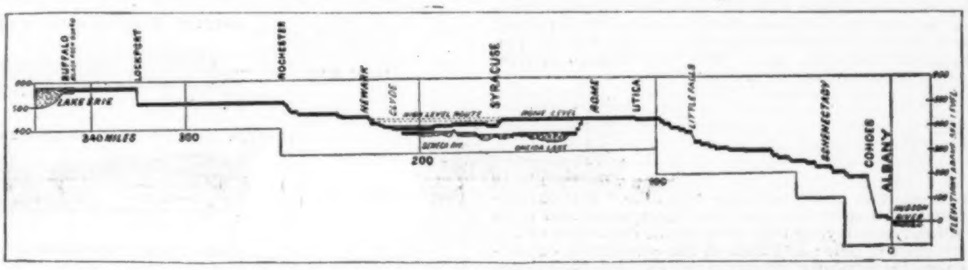
(c) The organization of the force engaged on the public works of the State on a more permanent basis, so as to afford an attractive career to graduates of scientific institutions, with the assurance that their entry into the service, their tenure of office, and their promotion will depend solely on their fitness, as determined by proper and practical tests.

(d) A revision of the laws in regard to the letting of public contracts by the State, so as to make impossible a repetition of the unfortunate results of the $9,000,000 appropriation.

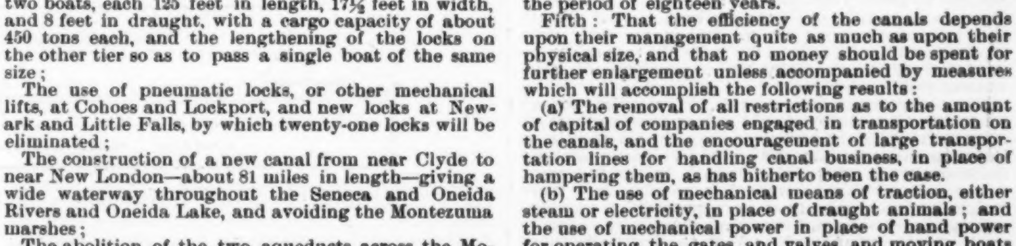
The reasons which have led us to these conclusions will be stated at length.

We have had an extended correspondence with civil engineers and others (including the principal commer-

MAP OF THE ERIE CANAL, SHOWING IN DOTTED LINES POSSIBLE NEW ROUTES.



PROFILE OF THE ERIE CANAL AND THE PROPOSED ALTERNATIVE ROUTES.



MAP SHOWING THE CANADIAN SYSTEM OF LOCKS AND CANALS ON THE GREAT LAKES AND THE ST. LAWRENCE RIVER.

cial bodies of New York city and Buffalo) familiar with the transportation problem, and this correspondence, together with the minutes of our various meetings, is submitted in a separate volume. While this correspondence displays a considerable difference of opinion as to the proper plan for improving the canals, yet the bulk of it is favorable to their improvement.

I.—SHALL THE CANALS BE ABANDONED?

The inestimable benefits which have been derived from the Erie Canal in the past are not disputed by any one. To it, more than to any other cause, is due the phenomenal growth and commercial supremacy of the city and State of New York. It opened up the great West to settlement, and in turn attracted the products of the West to the low-grade line through the Appalachian chain which exists only in the State of New York. The tolls on this water-way have more than repaid the cost of construction, maintenance, and operation; in addition, it has paid over $360,000,000 of freight money within the limits of the State, and the disbursement of this money along the line of the canal has built up the great interior cities from Buffalo to Albany, forming a continuous line of commercial centers, which has no counterpart in any other State. The growth of these cities in turn led to the construction of railroads paralleling the canal, and these by consolidation and scientific management have gradually reduced the cost of transportation during the last thirty years from an average of 2 cents per ton mile to about 6 mills per ton mile.*

No one disputes these evident facts; but the question which now confronts us is whether the railroads, with their large capital and scientific management, their durable roadbeds, powerful locomotives, larger cars, greater train loads, greater speed, and more certainty of delivery, will be able now or in the early future to reduce the cost of transportation below what is possible on the canals. If they can do this, then it is obviously unwise and improper to expend any more public money upon a method of transportation which, however important in the past, would no longer be able to compete with other and improved methods. The determination of this question seems to us to lie at the very foundation of the canal problem, and we have therefore given it the utmost attention.

The claim for the railroads has been put forward at great length, and with ability,‡ by The Engineering News, whose editorial articles on the subject are printed at length in the volume of minutes and correspondence. In brief, they are to the effect that while the average railroad charges in recent years on the railroads of New York State have been about 6 mills per ton mile, yet a lower rate has prevailed on grain, lumber, and similar articles, which have hitherto formed the bulk of the goods transported over the canal. The grain rates fixed in April, 1899, from Buffalo to New York were as follows per bushel:

Wheat	3½ cents.
Rye	3¼ "
Corn	2¾ "
Oats	2½ "

The rate of 3½ cents per bushel on wheat is about $1.17 per ton, or 2⅜ mills per ton mile. It is further argued in these articles that the Chesapeake and Ohio Railroad is carrying coal at a profit on a rate of 2¼ mills per ton mile; and that on the completion of locomotives now under construction by the New York Central and other railroads, designed to haul trains with from 2,000 to 2,400 tons of paying freight, the rate on such articles as grain, coal, ore, etc., by rail will be reduced to about 1 mill per ton mile. In other words, the argument in favor of the railways is that private enterprise and private capital will at an early date produce on the railroads as low a freight rate as can be produced on the canal by the expenditure of large sums of public money.

If this argument were correct, it is needless to say that no further money should be spent on the enlargement of the canals, but that they should remain in their present condition until plans could be carefully matured for the disposal of them. In our judgment the argument is not correct. It would carry more weight if it were advanced or approved by practical railway managers; and we therefore sent the articles to the presidents of the New York Central Railroad, of the Illinois Central Railroad, and of the Pittsburg, Bessemer and Lake Erie Railroad, the last of which was specially built under the most favorable circumstances for the express purpose of carrying ores and low-grade freight at a minimum cost from Conneaut on the lakes to Pittsburg. The reply of Mr. Fish is explicit that there is no probability of a rate of 1 mill per ton mile by rail in the near future. The reply of Mr. Callaway, while not so positive, leaves no doubt in the mind of the reader that the New York Central Railroad has no expectation of quoting any such rate. The reply of Mr. Reed states that during the past summer nearly a million tons of ore were hauled from Conneaut to Pittsburg at an actual cost for transportation alone of 1¼ mills per ton mile; the freight rate being 3·65 mills per ton mile.

It is evident, therefore, that the views expressed in The Engineering News are not sustained by practical railway managers, responsible to their stockholders for the profitable management of their roads.

The keeping of railway accounts is an intricate science; the system is not entirely uniform among different roads, and it is very difficult for any one to be able to state whether the carrying of grain at a rate equivalent to 2¼ or 2⅜ mills per ton mile is done at a loss or a profit. It is more than probable that it has been done at a loss, the corporate wealth of the railroads enabling them to carry this loss, provided they were making a profit on other classes of goods, and they considered it desirable to hold the business until on the return of more prosperous times they would be able to secure a profitable rate. It is to be noticed that these extremely low rates have prevailed during the hard times from 1893 to 1898, during which many manufacturers thought it better to keep their factories in operation at a loss rather than to close them entirely. With the return of prosperity during the two years just ending, the price of manufactured goods has increased from 30 to 60 per cent. (and more in some cases), and the railroads are already claiming that they have not shared in this prosperity, and that the time has come for an advance in railroad rates. Already the rate on grain across the State of New York has advanced from 3½ to 4 cents per bushel. The price of rails, cars, locomotives, and labor during the year 1900 will be very much in excess of what the railroads have been paying during the last few years, and this must inevitably be reflected in a considerable advance in freight rates. We believe, therefore, that the reduction in railroad rates, which has been almost constant for the last thirty years, has received a check, and that an increase may be looked for until the present prosperity shall be succeeded by depression, when it is probable that they will again decline; but it is very doubtful if they will go any lower, if as low, as the rates recently prevailing.

In our judgment, water transportation is inherently cheaper than rail transportation. It varies slightly with the size of the vessel and the restriction of the waterway. On the ocean, where the waterway is entirely unrestricted and the size of the vessel is the maximum, it averages about half a mill per ton mile;* on the lakes, where the vessels are not so large, and occasional restrictions are encountered on the waterway, it is about six-tenths of a mill per ton mile;† on the canals of New York, where the boats are very small, the waterway greatly restricted, and obsolete methods are employed for handling the business, it is about 2 mills per ton mile. By the enlargement of the canal which we recommend, and the introduction of improved methods of management, we believe that the canal rate can be reduced to two-thirds of 1 mill per ton mile, or very nearly as low as the lake rates. All of these rates have varied in the past and will vary in the future to correspond with prosperity or depression in general business. But there is every reason to believe that they will maintain a corresponding ratio, the ocean, lake, and canal rates being from one-third to one-fourth of those by rail. The reductions which may be made hereafter in the railroad rate can be met by similar reductions in all three classes of the water rates, provided the same methods of skilled management are applied to all.

ers to Buffalo and there transfer to the canal boat, which, of the size we have mentioned, can be safely taken to any point on the route between Buffalo and New York, or on the coast within the limits above named.

The system of using barges with detached motive power in the coastwise traffic between New York and New England has been in operation for many years, and has reached enormous proportions. It has hitherto been confined to low-grade articles, such as coal and oil, whereas the high-grade package goods have gone by steamboat. It is possible that this division may continue to be economical, and in that event a transhipment at New York between the steamboat and the canal boat would be necessary. But we feel certain that if the waterway across the State of New York is enlarged so as to afford facilities for boats of 1,000 tons, and is so managed as to produce safety and certainty of delivery by responsible transportation lines, and at a rate far below that now prevailing on the railroads, a very large business will develop along such route in all classes of goods, and at enormous benefit to the State of New York, and particularly to the two great cities at its eastern and western ends.

In considering this question of the relative advantages and cost of rail and water transportation, we have given much study to what is being done on the continent of Europe; and one of our committee, Mr. F. S. Witherbee, has visited Europe for the purpose of gaining information on this point. His report is transmitted herewith, and a large number of documents, plans, and photographs which he brought back have been deposited in the office of the State Engineer. It is found that on the continent of Europe, so far from the canals being decadent during the last thirty years, they have been constantly enlarged and improved, enormous sums having been spent for this purpose, and the result has been an extraordinary increase in this class of transportation. It is well known that the railroad rates in Europe are much higher than in America. There are several reasons for this. In Europe there is none of the long-haul traffic, which is so much less expensive to carry, and accounts for so large a part of the lower ton-mile rate in America. The management of the railroads is also less efficient. On the other hand, the management of the canals has been more efficient than with us. The result has been a far greater development in water traffic than in rail traffic during recent years in France, Belgium, Germany, and Russia.

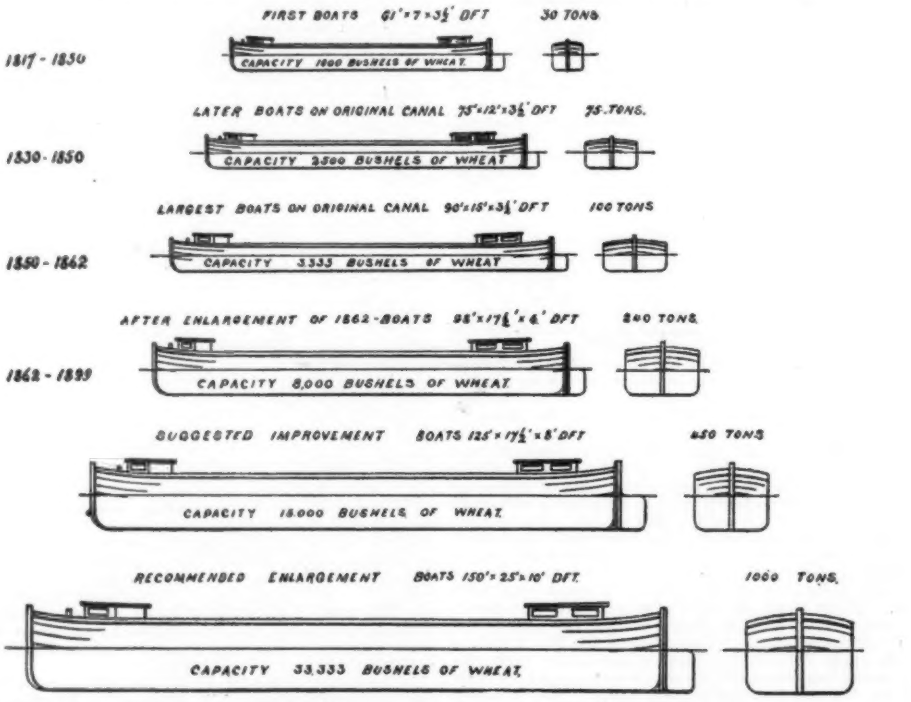


DIAGRAM SHOWING DIMENSIONS OF ERIE CANAL BOATS FROM 1817 TO 1900.

Moreover, the canals have been largely limited in the past to the lower grades of freight, and this is equally true of the transportation on the lakes. The canal has thus been in competition with the classes of freight which pay only between 2 and 3 mills per ton mile, and which the railroads will carry at a loss rather than lose the business, whereas, the railroads carry other classes of freight, some of which brings as high as 15 to 20 mills per ton mile, and the average freight, including the low grades, as we have seen, being about 6 mills. There is no reason why the canals, if enlarged and properly managed, should not compete for the higher grades of freight, which, at prices far below those charged by the railroad, would bring very profitable returns on the lakes and canal.

The local tonnage on the canals has for many years exceeded the through tonnage, just as it does on the railroads, although not to the same extent, and an enterprising transportation line, skillfully managed, could give an enormous development to this local traffic at profitable prices, and thus be in position, just as the railroads are, to carry through freight of low grade at cost or less in case of necessity. With the canal enlarged so as to carry boats of 1,000 tons each, and these boats assembled in fleets of four or six, with a total capacity of 4,000 to 6,000 tons, each fleet having detached mechanical motive power—the system of handling being analogous to that of a train composed of cars and a detached locomotive—it will be possible to send a boatload of freight of the highest or the lowest class through from any point on the lakes to any point on the Atlantic coast from Boston to Philadelphia. Experience will then prove whether it is more economical to send freight of different classes either all the way without breaking bulk, or to use the lake steamers to Buffalo and there transfer to the canal boat, …

In France, since the war with Prussia, over 400 miles of new canals and nearly 500 miles of new river navigation have been constructed, making nearly 7,000 miles of internal waterways; the water traffic has increased from 1872 to 1897 by 140 per cent., whereas the rail traffic has increased by but 75 per cent. The little State of Belgium has expended since 1860 not less than $50,000,000 for enlarging its canals, and the water traffic increased from 1888 to 1896 by nearly 40 per cent., and it is significant that the increase in the transportation of miscellaneous package commodities during the same period was 54 per cent.

In Germany, the same process of betterment and extension of canals and water routes is continued. During the past year the new canal from Dortmund to Emden has been completed, and opened for traffic; this canal being especially noteworthy for the famous pneumatic lock at Henrichenburg, where vessels are lifted 45 feet from one canal level to another at one operation. The modern type of canal boat in use on this canal is a barge of 1,000 tons carrying capacity, built of steel, about 230 feet long, 30 feet wide, and 7½ feet draught, and costing only $5,000 each. The propulsion is entirely mechanical—either by steam or electricity. It is well known that the German government is planning a trunk route between the rivers Rhine and Elbe, and is strongly in favor of a large extension of its canal system; and that its plans would now be in process of being carried out but for the opposition of the agricultural interest, which fears the effects upon its own property of the reduction in rates which would certainly follow the execution of these plans.

In Russia, even greater efforts have been devoted to

* Changes in the rates of charges for railway and other transportation services, by H. T. Newcomb. Published by the U. S. Department of Agriculture, 1898, page 19.

* It is stated by Mr. E. L. Corthell (Minutes and Correspondence, page 89), that wheat has been carried from California to England for three-tenths mill per ton mile, and coal on the return trip for one-fifth mill.

† On the lakes return cargoes of coal are carried from Lake Erie to Lake Superior ports, about 1,000 miles, for 25 cents, or ¼ mill per ton mile.

the development of the water routes on canals and rivers, the sum of $30,000,000 having been expended from 1891 to 1896 for this purpose, and in the same period the internal water traffic has increased by 70 per cent. This traffic on Russian internal waters accommodates 1,500 steamers and 60,000 canal boats, with crews numbering 300,000 men. Vessels 200 feet long can traverse the whole length of the country from the Caspian Sea to St. Petersburg or Archangel (2,500 miles).

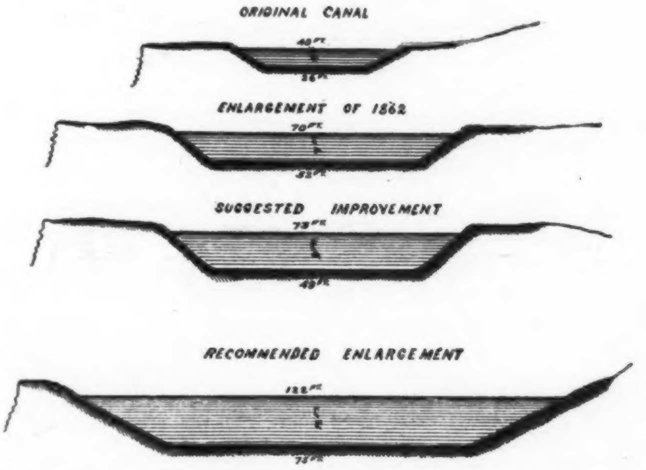
We do not think that these facts can be overlooked in the consideration of this problem. They show that in countries where the keenest competition exists not only within each country, but between each and its neighbor, effort is being made to gain an advantage, or, at least, keep on equality, in the competition, by reducing the rates of transportation, and that to accomplish this large sums of public money are being spent to enlarge and improve the water routes, thus confirming the general proposition that under equal conditions of management the water route, even in a restricted way like a canal, is cheaper than the rail route.

New York has certain topographical advantages which it would be folly not to utilize. Through the valleys of the Hudson and the Mohawk and the comparatively low and level lands west of Oneida Lake it is possible to construct a water route connecting the Great Lakes and the Atlantic coast, and no such water route can be constructed through any other State. It has no rival except in the St. Lawrence route. This State will inevitably have to compete with the routes by rail, and possibly by water, from the grain fields of the West to ports on the Gulf of Mexico. But in the transportation from the lakes to the Atlantic it has a great advantage, provided it is properly utilized. If the water route is abandoned, then New York must take its chances in the railroad competition with Portland, Boston, Philadelphia, Baltimore, Newport News, and Savannah. In this competition it is hardly on an equality even, but is subject to many disadvantages; the distance to the southern points is less than to New York; the other cities have harbors, which, while not so capacious and deep as that of New York, are still sufficient for the purpose, and the price of real estate and dockage at these several cities is very much less than in New York. If the city and State of New York are to take their chances in open railroad competition, then we must inevitably look to see the relative proportion of exports through New York constantly decreasing, as it has been for the last ten years. While New York may possibly hold its own in the actual volume of business, yet the increase will go to other cities, which, as railroad termini, offer greater advantages for through business; and the relative volume of the business coming to New York will steadily decrease. On the other hand, if the State of New York enlarges its water-way to the utmost limit, then it can be sure that it will offer the lowest transportation rate and will secure an increasing share of the business, notwithstanding the disadvantages it labors under in the matter of cost of terminals and handling.

The State of New York must be prepared to face from this time on a serious competition in the export trade over the St. Lawrence route. The Soulanges Canal, which was the last link in the improvements around the rapids of the St. Lawrence River, has been completed during the year 1899 and nominally opened for business. It will be actually opened for business with the spring of 1900. This chain of improvements gives a waterway from Lake Erie through the Welland Canal, Lake Ontario, the St. Lawrence River and its canals capable of carrying boats or barges of about 2,200 tons capacity; the size of the locks is 270×45×14, admitting vessels 255 feet long, and 12 to 14 feet draught, depending on the stage of Lake Erie. The expenditures for construction and enlargement of this route during the last fifty years have been over $56,000,000,* a sum which bears the same ratio to the wealth of Canada as $100,000,000 would bear to the wealth of the State of New York. The distance from Lake Erie to Liverpool by the St. Lawrence route is about 450 miles shorter than by any route across the State of New York.† It is certain that the Canadian government will do everything in its power to realize every possible advantage from this enormous expenditure. Already propositions have been submitted by a group of Chicago and Buffalo capitalists to the Harbor Commissioners of Montreal and accepted by the latter, the result of which will be to divert about 35,000,000 bushels of grain from the New York route. These propositions involve the immediate construction of at least 15 barges of the maximum size which can be used on the canal, and costing $100,000 each, in addition to elevators, warehouses and other structures in the harbor of Montreal, costing more than $4,000,000. These propositions contain no exclusive privileges, and it is open to another group of capitalists to make similar arrangements for the diversion of other large amounts of the grain which now passes through New York.

It is evident that the water route via the St. Lawrence on the one hand, and the short rail lines to Gulf ports on the other, will inevitably prove serious competitors in the future to the export trade of New York. If it desires to retain its export grain trade, it must improve its own water route to the utmost limit of which it is capable; it cannot retain this trade by taking its chances in the railroad competition of half a dozen routes from the lakes to the Atlantic.

It is not alone, however, the export grain trade which requires the enlargement of the Erie Canal. The chief argument for its construction eighty years ago was to have a cheap transportation route for grain and lumber, and this has continued to be its most important function down to the present time. But the changes which are now taking place in the iron trade give reason to believe that if an adequate water-way can be secured between Lake Erie and the Hudson River, the center of the iron industry can be brought within the State of New York. This has hitherto been within the State of Pennsylvania on account of its own resources in ores, coal and limestone. But the discovery within a comparatively recent period of almost inexhaustible beds of iron ore in the upper lake region, combined with cheap water transportation on the lakes, has led to the abandonment of its own ore and the substitution of those from the lakes. These ores can be laid down at any point on a water route between Buffalo and New York at less cost than they can be laid down in Pittsburg; there is also a great abundance of suitable limestone within the State of New York and adjacent to the water route; and the improvements which we recommend will make available the Lake Champlain iron ores as well as those of Cuba for a very economical mixture.



TYPICAL CROSS-SECTIONS OF ERIE CANAL FROM ITS INCEPTION TO THE PROPOSED ENLARGEMENT OF 1900.

The only advantage which Pittsburg would have over Buffalo or New York in the manufacture of iron and steel is in its greater proximity to the coking coals. It is believed that this advantage can be overcome by the saving in the cost of ore and limestone and the great saving in cost of transportation of the finished product. Between Pittsburg and tidewater the finished product must be transported a distance of 350 miles over a range of mountains, whereas from either Buffalo or New York, or any intermediate point on the water route, the enormous market for steel and iron in New York and New England, as well as abroad, can be supplied at greatly reduced charges for transportation.

The possibilities of manufacturing development along the banks of the Niagara River between the falls and Buffalo should not be overlooked in considering the transportation problem. Factories are already established in the vicinity of Niagara Falls utilizing the cheap power obtained from the falls to an extent of about 75,000 horse power, and these will be doubled within a very few years. The problem of transmission of power has been so far solved as to permit the lighting of Buffalo and the operation of its street-car system at a distance of 22 miles from the power house. It is probable that in less than ten years the transmission of power, at least as far as Rochester, will be commercially practicable. These advantages, if properly utilized, will make Western New York the center of such a manufacturing district as the world has never seen. The lakes give cheap transportation to the West, and it only needs a suitable water route to the Hudson in order to give cheap transportation eastward, which will enable these manufactured products to compete in every market in the world.

II.—THE SHIP CANAL PROJECT.

The enormous interest of the great West in the raising of food products, of which one-fifth is exported for foreign consumption, naturally leads the people of that section to seek the cheapest possible freight line for conveying such products to their final destination. They believe that an all-water route from the upper lakes to Europe will be of great benefit to them in enabling them to compete on more favorable terms with the grain producers of India, Russia, and the Argentine Republic. For many years this sentiment has been growing, and it has resulted in deep waterway conventions, at which much interesting statistical information has been brought forward, and much accomplished in the way of interchange of ideas. The sentiment of these conventions has been practically unanimous in favor of a water route of either 21 or 28 feet depth from Lake Erie to the Atlantic Ocean.

It seems to us that there are certain insuperable difficulties in the way of a ship canal ever being a success, no matter by whom constructed. It is intended to be used by a vessel which can navigate the ocean, the canal, and the lakes. We do not believe that such a vessel can be constructed so as to be economically and commercially successful. The ocean steamer is built to withstand the fierce storms of the Atlantic, and costs in its most modern type about $71 per net ton of carrying capacity.*

The vessel to navigate the lakes is built to withstand less frequent and dangerous storms; it has less draught, on account of the smaller depth of the harbors on the lakes, and it is built much less substantially; its cost is about $36 per net ton of carrying capacity.†

The cost of a canal fleet, consisting of a steamer and three consorts, with a total cargo capacity of 3,900 tons, according to figures furnished us by boat builders, would be $28,500,‡ or $7.31 per ton.

We have, then, the difference in first cost between $71, $36 and $8 per ton of carrying capacity for the three types of vessels which, in the evolution of business, have been produced as the most economical for the particular class of work each has to do. We do not believe that it is possible to combine these three types into one vessel which will be as economical for the through trip as to use the three existing types with two changes of cargo, one at Buffalo and one at New York, or to use the boat of 1,000 tons capacity going through from the lakes to New York and there transferring its cargo to the ocean steamer.

The average speed on the Suez Canal is only 6 miles per hour, and this on a canal with a total length of about 90 miles, of which fully two-thirds is a large lake. In a restricted waterway 350 to 400 miles long we do not believe that ocean steamers or lake steamers could attain an average speed exceeding 5 miles an hour. They are built to run from 15 to 20 miles an hour, and if they were only run at 5 miles an hour we think that in order to be profitable the now existing rates on the ocean and lakes of about one-half of a mill per ton mile would have to be very largely increased.

Finally, we think that this project is not one for serious consideration by the State of New York, because there are as yet no data which would enable any one to give even an approximate estimate of its cost. We have seen various statements placing the cost of a ship canal at figures ranging from $125,000,000 to twice or even three times that sum. None of them are founded on data sufficiently accurate to justify careful examination. The Board of Engineers on Deep Waterways is now preparing its estimates, and these will be the first based on adequate surveys. Until their figures are known, all we can say is that a ship canal will cost very much in excess of the project which we recommend. On the other hand, it will not in our judgment produce a freight rate, or other advantages, commensurate with this increased cost.

While, therefore, it seems eminently a proper subject for consideration by the Federal Government, even though, as is probable, the result of such an examination shall be the abandonment of the project, we do not think it is a subject which should receive any serious consideration from the State of New York.

(To be continued.)

THE SIMPLON TUNNEL.

On November 13, 1898, work was begun on the Simplon tunnel. The contract calls for its completion in five and one-half years, and the price to be paid is 69,500,000 francs ($13,413,500), says Consul Frankenthal, at Berne. It will have a length of 20 kilometers (12·4 miles), and will be the longest tunnel in the world. When completed, it will be the third one connecting Italy with outlying countries by direct rail, and will accomplish a saving of 77 kilometers (43·5 miles), or from 7 to 8 per cent. on travel from Paris to Milan, as compared with the Mont Cenis or St. Gothard tunnels. The Mont Cenis tunnel has a length of 13 kilometers (8 miles), and the St. Gothard a length of 15 kilometers (9·3 miles).

When in the fifties the wonderful project of drilling the Mont Cenis tunnel was undertaken, fathered by the courageous Italian Minister of State, Cavour, no machines for drilling were in existence, and it was calculated that a period of twenty years would be necessary for every 5 kilometers (3·1 miles) of tunnel drilled. Then Engineer Sommeillier, in charge of the work, constructed the first drilling machine; and, although crude, it was satisfactory enough to accomplish ten times the work done by manual labor, and enabled him to finish the tunnel in eleven years. The St. Gothard tunnel was finished in from eight to nine years.

The Simplon tunnel begins in Switzerland near the little town of Brig, in the valley of the Rhone, Canton Wallis, and ends in the valley of the Diveria, on the Italian side near Isella. It will be perfectly straight, except for a small curve at the ingress and egress. The contract for the tunnel provides for a fine of 5,000 francs ($965) per day if the time limit is exceeded, while a gratuity of the same amount per day is to be given if it is finished before the stipulated period. A little computation will show how disastrous strikes will be. A strike of ten days has just ended.

The fundamental principle in tunneling always has been to drive the hole, excavate, and follow it up with the finishing masonry, making provision, of course, for ventilation, which is generally sufficient at first, but which becomes insufficient when the work progresses toward the center, when the incoming fresh air mixes with the outgoing gases. The method employed

* Annual Report, Department of Railways and Canals of Canada 1898, I. p. 43.

† Port Colbourn to Montreal .... 375 miles.
Montreal to Liverpool .... 3,220 "
Total .... 3,595 "
Port Colbourn to New York .... 500 "
New York to Liverpool .... 3,540 "
Total .... 4,040 "
Proceedings of Deep Waterways Association 1895, p. 168.

* Report of Major T. W. Symons, in Report of Chief of Engineers U. S. Army for 1897, p. 3174.

† Ibid. p. 3176. These figures were based on the actual cost of vessels constructed between 1893 and 1896. At the present time, owing to the increased price of steel, the cost of each would be largely increased.

‡ The Cleveland Steel Canal Boat Company estimates that steel canal boats of the above capacity (150 feet long, 25 feet wide, and 10 feet draught) will cost $15,000 for each consort, and $25,000 for a steamer, which is $18 per ton of cargo capacity for a fleet of four boats.

by Engineer Brandt, who has been in charge of the undertaking, is to drive two holes parallel within the radius of the excavations, leaving a dividing line, one hole being excavated about 17 meters (55¾ feet) in advance of the other. These are built for a single track, and later on the dividing wall can be broken through for double tracks if necessary. At distances of about 200 meters (656 feet) transverse connections between the tunnels are made through the dividing wall and are provided with doors. To obtain sufficient ventilation, powerful air blasts are blown into one side of the tunnel, which return through the other side of the divide, and thereby conduct outward all foul air and bad gases. When the air in the interior increases in heat, it is cooled by showers of cold water, which has been led from the exterior of the mountain under high pressure. Through practical experiments in the mines of Spain, Engineer Brandt has proved that air at 50° C. (121° F.) by this means can be reduced to 15° C. (59° F.) These same streams furnish 1,000 horse power for driving drills. The miners, therefore, always work in an artifical atmosphere of cool fresh air.

Engineer Brandt's invention is a hydraulic rotary drilling machine, by which it is hoped to complete the tunnel in less than contract time. It is used singly and in battery form. Prominent engineers come from far and near to examine this powerful mechanism.

Another of Mr. Brandt's inventions is a machine for loosening and removing the débris after the explosions and blasts. It throws a powerful stream of water in a jerky manner into the stones loosened by the force of the blasts, thereby washing away the dirt. This makes excavation easier. These machines run on rails, and when in use follow each other in rotation.

The historical museum of the Kaiserlich und Königlich State Railroads in Vienna possesses the first hydraulic rotary machine invented by Brandt, which he used in tunneling through the Arlberg, in Austria, in 1867.

During November, in which ten days were lost on account of the strike, there was drilled at the south side 144 meters (472 feet), and at the north side 123 meters (404 feet). The total since the commencement of the work is 3,574 meters (about 2¼ miles)—2,148 meters (1⅓ miles) at the north side and 1,426 meters (nine-tenths of a mile) at the south side.

On November 22, 1899, the telegraph brought the news of the death of Mr. Brandt.

Notes from Dawson City.—Preparations are being made by the Canadian Government for establishing the winter trail to Bennett, which, owing to an overland cut-off at Fort Selkirk, thence to Lake La Barge, will be 110 miles shorter than the route followed last year, says Vice Consul Ronald Morrison, of Dawson City.

IMPROVEMENTS IN DAWSON.

While Dawson has lost in population during the past summer, it has gained in wealth, and is now a thriving, substantial town. The Yukon council has expended in building roads and trails during the year about $70,000 out of the $175,000 appropriated for this purpose by the Dominion Government. Considerable improvement work has been done on the streets, and $15,000 has been expended on drains and ditches, which has had the effect of improving the sanitary condition of the town. Already many physicians have left Dawson for want of practice, and no less than five private sanitariums have closed on account of lack of patronage.

The town is now equipped with two steam fire engines, fourteen patent fire extinguishers, one hook-and-ladder truck, two hose carts, and 6,000 feet of hose, and has a paid fire department of twenty men. A working head of steam is kept on the engines at all times.

MINING.

The 10 per cent. royalty on the season's output this last summer amounted to $700,000; last year, the total collected was $400,000. The output this year is generally estimated at $15,000,000; last year it was less than $12,000,000. The introduction of steam thawers, steam hoists, and other time and labor-saving machinery on all the creeks has practically ushered in a new era in the working of the mines and should produce astonishing results. As we are now in telegraphic communication with the rest of the world, capital is fast following on the heels of the prospector, and the outlook for the coming season is most promising.

CAPE NOME.

The excitement caused by the reports of the phenomenal richness of this new camp has not by any means abated. Many will attempt to make the trip this winter down the river, which seems a foolhardy undertaking, considering the dangers to be encountered and the distance to be covered over the ice and snow.

It is generally admitted, however, that after the river opens the route to Nome by way of Skagway, thence down the lakes and rivers past Dawson and on to St. Michael, is the most practical and safest. The spring floods drive the ice out of the Yukon River and away from the shore line between St. Michael and Cape Nome fully one month before the moving of the pack ice in the Bering Sea, which has to clear away before steamers can venture along the coast to Cape Nome.

Bicycles in Antigua.—Consul Hunt, of Antigua, British West Indies, in response to the inquiry of a New York company, writes under date of November 27:

There are about fifty bicycles in this island (population, 35,000) as against half that number a year ago. All but four or five are of American manufacture, and are owned by natives. Three conditions militate against a more extensive use of the wheel, viz.: The poverty of the people; the tropical heat, which renders riding between 8 A. M. and 4 P. M. almost impossible, especially for whites; and the abominable condition of the roads leading between the various points of the island. When it is stated that the method of road repairing in Antigua is to spread on the ground a thick layer of stone cut to about double the size of a walnut and leave it to be trodden down by passing ox carts or other teams, or the bare feet of native pedestrians, it will be appreciated that wheeling can be indulged in only under extraordinary difficulties.

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